# 2.2 Control System JL4G18-D

## 2.2.1 Specifications

### 2.2.1.1 Fastener Tightening Specifications

| Applications | Model | Specifications | |
|---|---|---|---|
| | | Metric (Nm) | US English (lb-ft) |
| Camshaft Position Sensor Retaining Bolts | M6X14 | 8-10 | 6.0-7.4 |
| Crankshaft Position Sensor Retaining Bolts | M6X12 | 8-10 | 6.0-7.4 |
| Ignition Coil Retaining Bolts | M6X35 | 7-11 | 5.2-7.8 |
| Engine Control Module Retaining Bolts | M6X16 | 8-10 | 6.0-7.4 |
| Engine Coolant Temperature Sensor Bolts | M12 × 1.5 × 6 | 15 | 11 |
| Evaporative Emissions Canister | M6X20 | 7-9 | 5.2-6.7 |
| Evaporative Emissions Canister Solenoid Valve Bracket Retaining Bolts | M6X20 | 7-9 | 5.2-6.7 |
| Fuel Filter Mounting Bracket Assembly Retaining Bolts | M6X16 | 8-10 | 6.0-7.4 |
| Fuel Filter Mounting Bracket Retaining Bolts | M6X16 | 8-10 | 6.0-7.4 |
| Fuel Rail Retaining Bolts | M6X20 | 10 | 7 |
| Fuel Tank Retaining Bolts | M10X30 | 38-46 | 28.1-34.0 |
| Idle Air Control Valve Retaining Bolts | M4X10 | 2-3 | 1.5-2.2 |
| Knock Sensor Retaining Bolts | M8X30 | 15-22 | 10.7-16.0 |
| Intake Manifold Absolute Pressure and Temperature Sensor Retaining Bolts | M6X12 | 8-10 | 6.0-7.4 |
| Oxygen Sensor Retaining Bolts | M18X8 | 44 | 32.6 |
| Air-Conditioning Compressor Mounting Bolts | M8X80 | 25 | 18.2 |
| Spark Plug Retaining Bolts | M14 × 1.25 × 22 | 20-30 | 14.8-22.2 |
| Throttle Body Retaining Bolts | M8 | 20-25 | 14.8-18.5 |

### 2.2.1.2 Temperature Sensor Temperature and Resistance Correlation

| Temperature (°C) / ( °F) | Resistance (Ω) |
|---|---|
| -30/-22 | 26,000 |
| -25/-13 | 19,000 |
| -20/-4 | 15,000 |
| -15/5 | 11,800 |
| -10/14 | 9,000 |

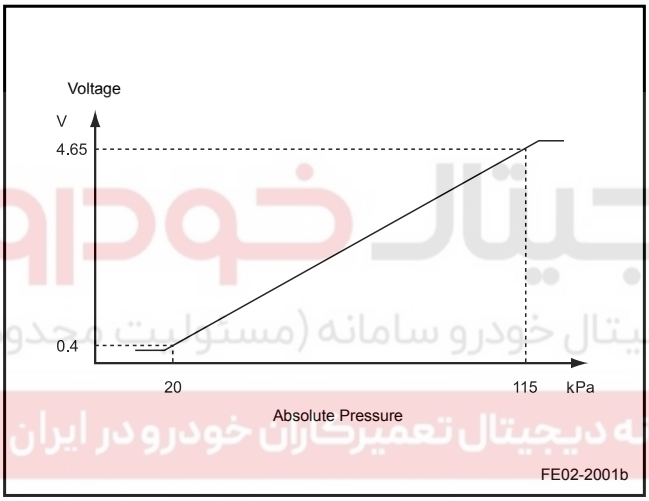
| Temperature (°C) / ( ºF) | Resistance (Ω) |
|---|---|
| -5/23 | 7,000 |
| 0/32 | 5,600 |
| 5/41 | 4,600 |
| 10/50 | 3,600 |
| 15/59 | 3,000 |
| 20/68 | 2,400 |
| 25/77 | 2,000 |
| 30/86 | 1,700 |
| 35/95 | 1,400 |
| 40/104 | 1,180 |
| 45/113 | 950 |
| 50/122 | 800 |
| 55/131 | 700 |
| 60/140 | 600 |
| 65/149 | 510 |
| 70/158 | 425 |
| 80/176 | 320 |
| 90/194 | 240 |
| 100/212 | 180 |
| 110/230 | 140 |
| 120/248 | 110 |
| 130/266 | 90 |

### 2.2.1.3 Altitude and Atmospheric Pressure Correlation

| Altitude (m)/(ft) | Atmospheric Pressure (kPa)/(psi) |
|---|---|
| 4,200/13,780 | 55/8 |
| 3,900/12,795 | 58/8.4 |
| 3,600/11,811 | 61/8.8 |
| 3,300/10,827 | 64/9.3 |
| 3,000/9,843 | 66/9.6 |
| 2,700/8,858 | 69/10 |
| 2,400/7,874 | 71/10.3 |

| Altitude (m)/(ft) | Atmospheric Pressure (kPa)/(psi) |
|---|---|
| 2,100/6,890 | 74/10.7 |
| 1,800/5,906 | 77/11.2 |
| 1,500/4,921 | 80/11.6 |
| 1,200/3,937 | 83/12 |
| 900/2,953 | 87/12.6 |
| 600/1,969 | 90/13.1 |
| 300/984 | 93/13.5 |
| 0 | 100/14.5 |

### 2.2.1.4 Intake Air Pressure Sensor Voltage and Pressure Diagram



## 2.2.2 Description and Operation

### 2.2.2.1 Overview

The engine use an electronic control system manufactured by UAES(United Automotive Electronic Systems Co., Ltd.). It consists of the engine control module (ECM), ECM working circuit, system input and output parts. ECM is located at the right side of the Air-Conditioning blower and is the engine control system control center. It continues to monitor the signals from various sensors and controls the various systems performance. Engine control module also performs system diagnostics, it can identify the operational malfunction and through the malfunction indicator light (MIL) to remind the driver and store DTC codes in order to facilitate maintenance personnel for maintenance.

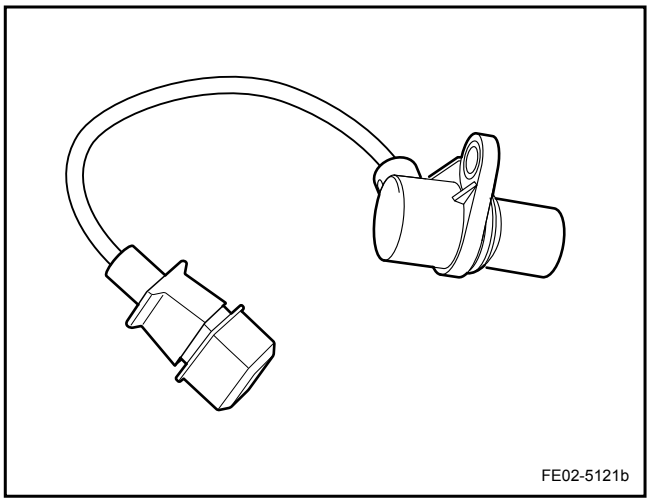
If the engine control module is damaged, there is no single spare part within the module can be repaired. ECM must be replaced as a whole.

Input components: crankshaft position sensor (CKP), camshaft position sensor (CMP), intake air pressure and temperature sensors [intake air pressure sensor (MAP), with intake air temperature sensor (IAT)] , knock sensor (KS), throttle position sensor (TPS), evaporation tank surface temperature sensor, engine coolant temperature sensor (ECT), vehicle speed sensor (VSS), pre-catalytic heated oxygen sensor ($HO_2S$), post-catalytic heated oxygen sensor ($HO_2S$), air conditioning pressure switch, power steering switch, defrost heating enable input, CAN information input, serial data bus input.

Output components: idle speed control valve (IAC) ,1-2-3-4-cylinder fuel injectors, ignition coils, variable valve timing solenoid valve (VVT), canister solenoid valve (EVAP), the main relay, pump relay and oil pump, cooling fan low speed relay, cooling fan high speed relay, air-conditioning compressor relay, CAN information output, serial data bus out.

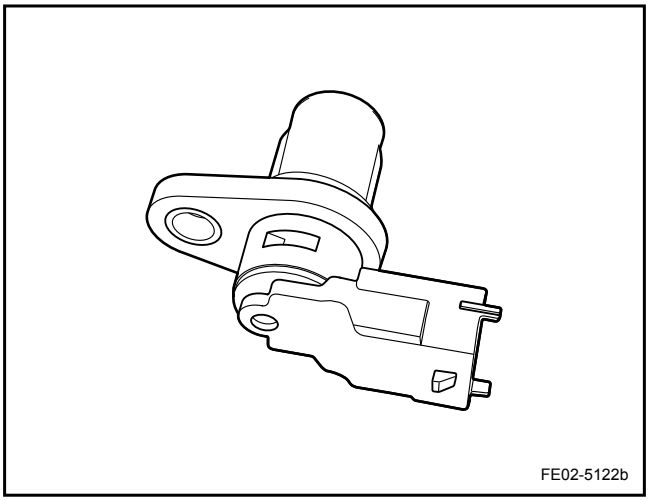
### 2.2.2.2 Input Components

1. Crankshaft Position Sensor (CKP)



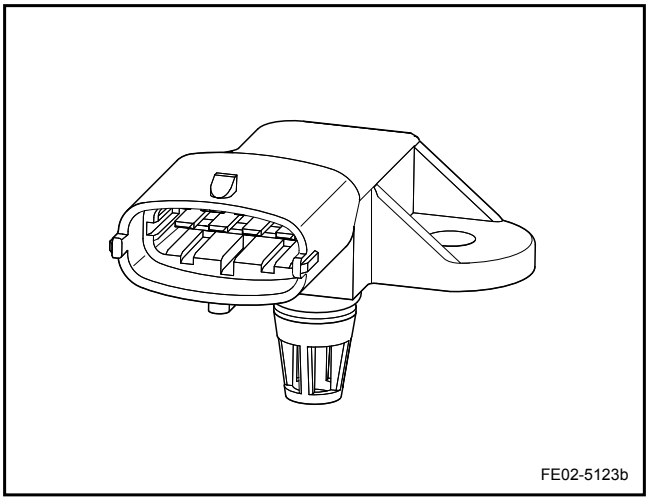

The crankshaft position sensor output can be used to determine crankshaft position and rotation speed. Crankshaft position sensor is a magnetic-electric sensor, which is installed in the front end of the transmission housing, and tightened with bolts, below the coolant temperature sensor. Flywheel signal plate and the crankshaft sensor is an integrated part. The sensor extends out through the bearing. The gap between the sensor and the signal plate teeth is below 1.2mm. The signal plate has 58 machined slots, of which 57 slots have a 6 ° interval. The last tooth slot is wider, used to generate synchronization pulses. When the crankshaft rotates, the sensor plate slot will change the sensor magnetic field, resulting in an induced voltage pulse. The 58th slot pulse is longer and can be used to identify a specific direction of the crankshaft, so that the engine control module (ECM) may at any time determine the direction of the crankshaft. Engine control module uses this information to generate the ignition timing and fuel injection pulse, and then controls the ignition coil and fuel injectors. Sensor signals pass through ECM harness connector EN01 terminal No.46,47 to ECM, if the engine control module detects the sensor signals erratic or incorrect, it will record DTC code P0321, P0322. and DTC code P0016 will be recorded when the camshaft relative position is not correct.

2. Camshaft Position Sensor (CMP)



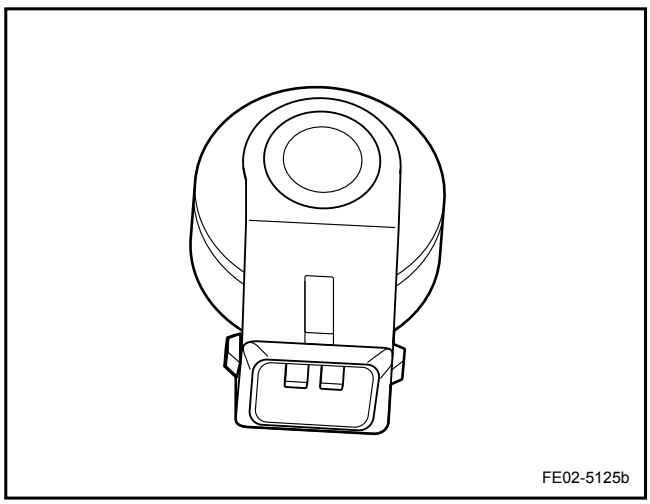

Engine control module receives this signal as a sync pulse, according to an appropriate sequence to trigger the fuel injectors. Engine control module uses the camshaft position sensor signals to instruct cylinder No.1 piston position during power stroke. Engine control module then calculates the actual fuel injection sequence. If when the engine is running, the camshaft position sensor signal is lost, the fuel injection system will be converted to a fuel injection pulse based on the previous calculation of the fuel injection model, while the engine will continue to run. Even if the fault exists, the engine can be restarted. Sensor signals pass through ECM harness connector EN01 terminal No.42 to ECM. When the engine is running if the control module detects an incorrect camshaft position sensor signal, it will record DTC code P0340, P0341, P0342, P0343. DTC code P0016 will be recorded when the crankshaft relative position is incorrect.

3. Intake Air Pressure and Temperature Sensor



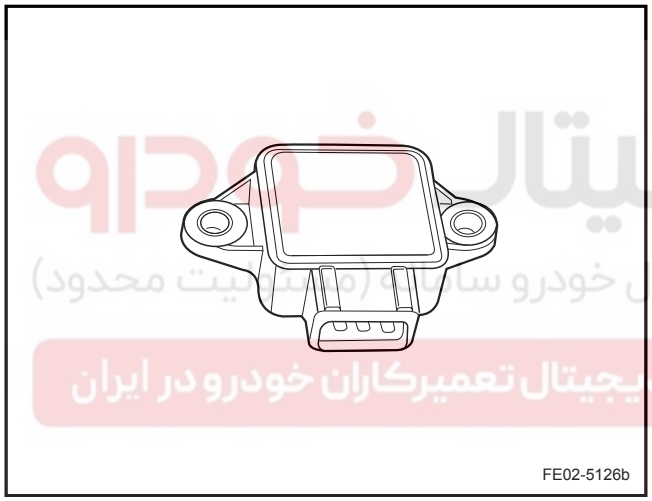

Intake air pressure and temperature sensor has an intake pressure sensing element and a thermistor. When the engine is working, the engine intake pressure sensing element produces the intake air pressure signal, negative temperature coefficient thermistor produces intake air temperature signal. This sensor detects intake manifold pressure change caused by engine load and speed changes. These changes will be converted to the voltage output. When the engine decelerates, the throttle body closes resulting in a relatively low intake manifold absolute pressure output. Intake manifold absolute pressure and vacuum degree is opposite. When the manifold pressure is high, the vacuum is low. MAP sensor is also used to measure atmospheric pressure. This measurement is calculated as part of the MAP calculation. When the ignition switch is turned on and the engine is not running, the engine control module reads atmospheric pressure as the intake manifold pressure, and adjusts the Air-Fuel ratio accordingly. With this kind of altitude compensation, the system can maintain a low emissions while maintaining maneuverability. Sensor signal passes through ECM harness connector EN01 terminal No.19 to ECM. When MAP sensor and its circuit malfunction occurs, DTC P0105, P0106, P0107, P0108 will be recorded. DTC code P0105, P0106, P0107, P0108 will be recorded when MAP sensor and its circuit have malfunctions. Engine control module provides 5V voltage to the thermistor and measure the voltages change to determine the intake air temperature. The engine control module obtains the intake air temperature by measuring the voltage. ECM uses this signal to adjust the injector pulse width and ignition timing. Sensor signals pass through ECM harness connector EN01 terminal No.25 to ECM. DTC code P0112, P0113 will be recorded when there is a circuit malfunction.

4. Knock Sensor (KS)



Knock sensor is a frequency response sensor, installed in the engine block the most sensitive to knocking part, the lower intake manifold. ECM uses knock sensor to detect knock intensity, and then to adjust the ignition advance angle, to effectively control knocking and optimize the engine power, fuel economy and emission levels. If the engine knocking occurs, ECM will receive the signal, filter out the non-knock signals and determine engine cycle calculated by camshaft and crankshaft position sensor signals. ECM determines the cylinder in which the knock occurs and will delay the ignition advance angle for this cylinder until the knock disappears. Then ECM advances the ignition advance angle until the ignition angle is best suited for the operating conditions at that time. Sensor signals pass through ECM harness connector EN01 terminal No.30,31 to ECM. DTC code P0327, P0328 will be recorded by ECM where there is a KS sensor malfunction.

5. Throttle Position Sensor (TPS)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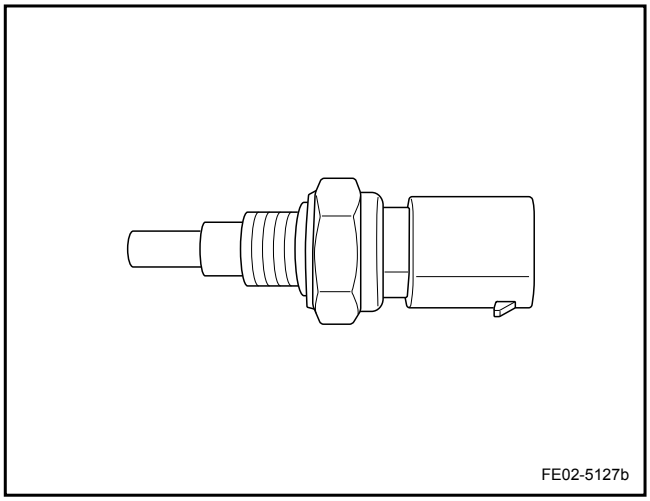
Throttle position sensor is installed on the throttle body connected with the throttle shaft. Within the sensor, it is actually a sliding variable resistor, with a 5 V reference voltage and a ground provided by ECM. Engine control module monitors the signal voltage to calculate the throttle position. Because it is connected with the throttle shaft, so the output signal changes as the movement of the accelerator pedal. When the throttle is closed, the sensor output voltage is low, about 0.3-0.9 V. With the throttle opening the output voltage increases, when the throttle is fully open, the output voltage is about 4.5 V. Sensor signals passe through ECM harness connector EN01 terminal No.26 to ECM, ECM adjusts fuel injection amount based on this signal. DTC code P0122, P0123 will be recorded when there is a sensor circuit malfunction.

6. Engine Coolant Temperature Sensor (ECT)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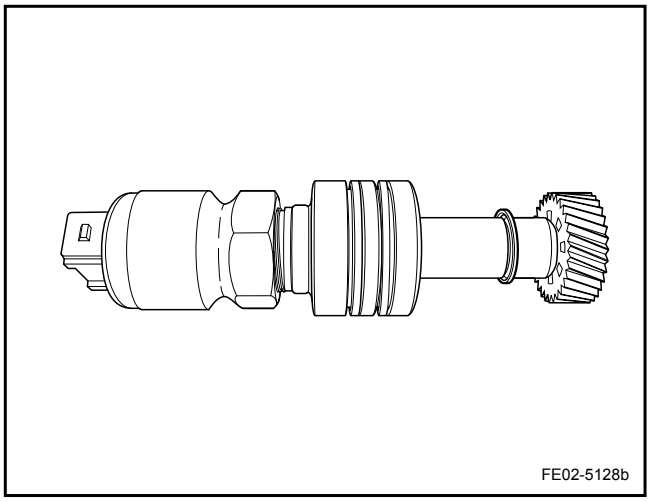
Engine coolant temperature (ECT) sensor is a thermistor and its resistance changes as the temperature changes. It is installed in the engine coolant flow. When the coolant temperature is low, the resistance is high. At -30 °C (-22 °F) the resistance is 26,000 Ω; at 130 °C (266 °F), the resistance is 90 Ω. ECM provides a 5 V voltage to the sensor. When the engine is cold, the voltage is high. When the engine is hot, the voltage is low. The coolant temperature signal is important to the ignition timing and fuel injection adjustment, while the signal is also transmitted to the instrument panel (IP) through the CAN network, used to display the current engine working temperature. Sensor signals pass through ECM harness connector EN01 terminal No.41 to ECM. DTC code P0117, P0118 will be recorded when there is a sensor or circuit malfunction.

7. Vehicle Speed Sensor (VSS)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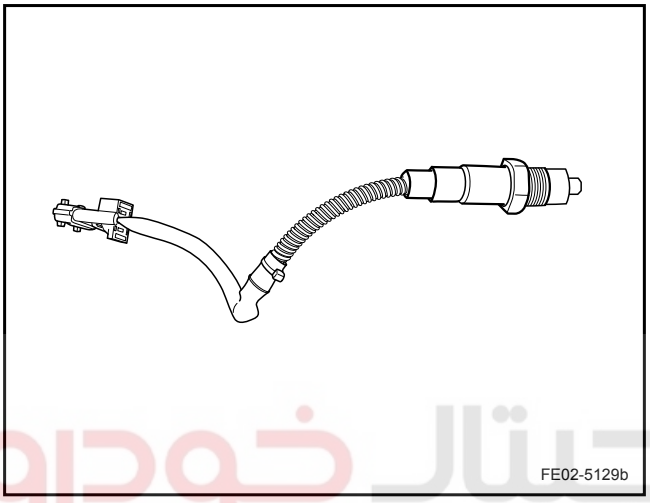
The vehicle speed sensor is installed in the front transmission case, connected with differential speed sensor drive gear. Speed sensor is a Hall-style. The main relay controlled by ECM provides the sensor working power. When the vehicle is driving, the sensor output is a rectangular pulse signal. Sensor signals pass through ECM harness connector EN01 terminal No.57 to ECM. DTC code P0501 will be recorded when there is a sensor or wiring malfunction.

### 8. Pre-Catalytic Heated Oxygen Sensor ($HO_2S$)




Pre-Catalytic oxygen sensor is installed in the exhaust manifold, the three-way catalytic converter front-end, detecting the oxygen content of exhaust gas and sending ECM the indirect mixture concentration. ECM adjusts fuel injection pulse width, to make sure that the mixture ratio is close to the theoretical value of about 14.7. Oxygen sensor has a sensing element, which is a porous ceramic tube, the outer wall surrounded by the engine exhaust and inside connecting to the atmosphere. Sensing ceramic wall is a solid electrolyte containing an electric heating tube. When the sensor ceramic tube temperature reaches 350°C (662 ºF), it has a solid electrolyte properties. Oxygen sensors work by converting ceramic oxygen ion concentration difference between inside and outside into a voltage signal output. The output voltage level is due to movement caused internal electronic ceramic tubes. If the mixture is rich, then the ceramic oxygen ion concentration difference between inside and outside is high, electrical potential difference is high, a large number of oxygen ions move from the inside to the outside, the output voltage is high (close to 800mV). If the mixture is lean, then the ceramic oxygen ion concentration difference between inside and outside is low, electrical potential difference is low, only a small amount of oxygen ions move from inside to outside, the output voltage is low (close to 200mV). Signal voltage suddenly changes near the theoretical Air-Fuel ratio (λ=1). Sensor signals pass through ECM harness connector EN01 terminal No.45 to ECM. DTC code P0030, P0031, P0032, P0053, P0130, P0131, P0132, P0133, P0134, P2195 , P2196 will be recorded when there is a sensor, wire or circuit malfunction.

### 9. Post-Catalytic Heated Oxygen Sensor ($HO_2S$)

Post-Catalytic oxygen sensor is installed on the three-way catalytic converter rear end. Its working principle is the same as the Pre-Catalytic oxygen sensor. If the three-way catalytic converter is working properly, fuel control system is in close-loop control, the sensor output voltage is stable at 0.45V. Sensor signals pass through ECM harness connector EN01 terminal No.29 to ECM. DTC code P0036, P0037, P0038, P0054, P0136, P0137, P0138, P0140, P2270, P2271 will be recorded if there is a sensor, signal or circuit malfunction. DTC code P0420 will be recorded if the Post-Catalytic oxygen sensor detects that three-way catalytic converter is not working properly.

### 10. Air-Conditioning Pressure Switch

Air-Conditioning pressure switch is installed in the Air-Conditioning high pressure side pipeline, mainly for Air-Conditioning system control. ECM command the compressor control relay only when correct signal is received, so that the electromagnetic compressor clutch pull-in. Switching signals pass through ECM harness connector EN01 terminal No.10, 44 to ECM. DTC code will not be recorded when there is a switch or circuit malfunction.

### 11. Power Steering Switch

Power steering switch is installed on the power steering pump. When the steering wheel is operated, power steering pump oil pressure changes due to increased power steering pump load. If at this point, the engine is in idle state, it will cause the engine idle fluctuate. In order to make the engine run smooth, after ECM receives the signal, it will increase the engine's torque. A typical way is to increase the fuel injection amount. Switching signals pass through ECM harness connector EN01 terminal No.12 to ECM. DTC code will not be recorded when there is a switch or circuit malfunction.

12. Defrost Heating Enable Input

The signal is provided by the BCM through a dedicated circuit and is a voltage signal. The rear defrosting heating block is essentially a resistance wire with fairly high heating power. The power consumption is relatively high. When the rear defrost heating starts, the generator load increases, causing the engine speed fluctuate. In order to make the engine run smoother, after ECM receives the signal, it increase the engine's torque output. Switching signals pass through ECM harness connector EN01 terminal No.24 to ECM. when the signal fails, ECM does not record the relevant DTC code.

13. CAN Information Input

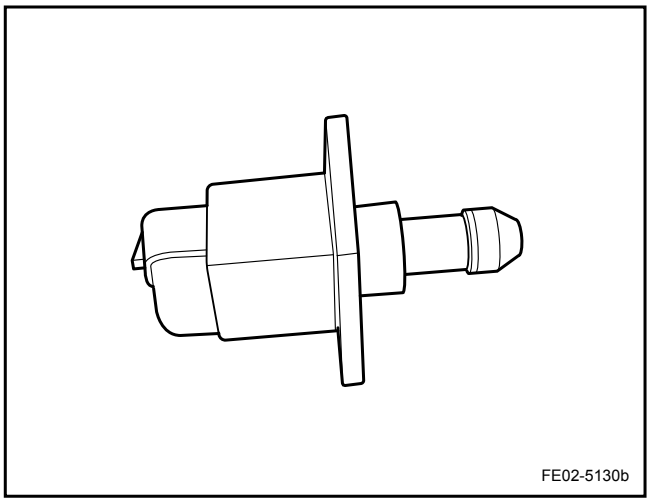
ECM downloads signals via CAN from the network for its own needs. The most typical signals are: brake switch signal, ABS's work status. CAN_HI signal circuit connects to other CAN network modules through ECM harness connector EN01 terminal No.33. CAN_LO signal circuit connects to other CAN network modules through ECM harness connector EN01 terminal No.34. If ECM fails to communicate with other modules, it will record DTC code U0001, U0121, U0140, U0151, P1523.

14. Serial Data Bus Input

When the ignition switch is turned on, the Anti-theft ignition coil identifies whether the inserted key is an illegal key. The signal is transmitted by the security module to ECM. ECM determines whether to activate the engine Anti-theft locking system based on this signal, such as cutting off the ignition, fuel injection, start the circuit. ECM harness connector EN01 terminals No.15,23 are for serial data communication. The immobilizer system-related failures DTC codes are P1610, P1611, P1612, P1613, P1614.

## 2.2.2.3 Output Components

1. Idle Speed Control Valve (IAC)

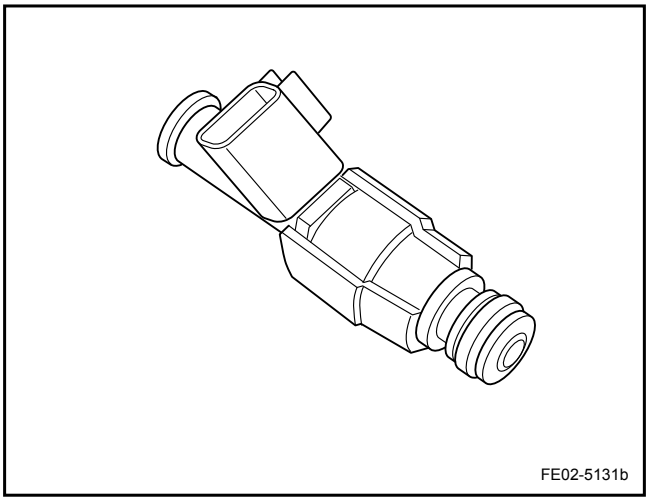



Note

A. Do not to push and pull IAC valve core shaft, otherwise it will damage the internal valve components.
B. When washing the IAC valve carbon residue, do not let any cleaning agent enter the IAC valve inside, otherwise it will damage IAC valve.

IAC valve is installed on the throttle body. ECM controls the spool extended the amount to control the idle speed. Engine sends the control module voltage pulses to the IAC valve motor windings, so that IAC valve core shaft moves to the inside or outside a certain distance (step or a count) with each pulse. Shaft movement controls the air flow amount bypass the throttle, and then controls the engine idle speed. The expected idle speeds of all engine running conditions are programmed and set in the ECM calibration program. These settings includes engine speed based on engine coolant temperature, speed, battery voltage, and Air-Conditioning system pressure. Engine control module reads the correct IAC valve position to meet the expectations of stable, warm-up idle speed under different conditions. This information is stored in the engine read-only memory, even after the ignition switch is switched off, the information will not be cleared. If the engine control module power supply is disconnect, it will lead to an incorrect idle speed control. When starting, press the accelerator pedal half way until the engine control module learns idle speed control. ECM controls IAC valve through ECM harness connector EN01 terminals No.21,22,35,36. If the idle speed control valve position does not match the actual ECM required location, DTC code P0506, P0507 will be recorded. If idle speed control valve circuit has a malfunction, DTC code P0508, P0509, P0511 will be recorded.

2.Cylinder No.1,2,3,4 Fuel Injectors



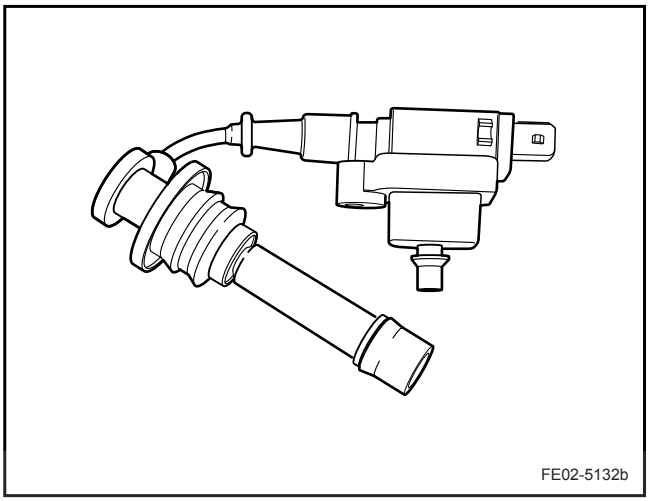

Fuel injector is installed on the cylinder cover, in front of intake valve. Based on ECM's instructions, it injects fuel during specific period of time, to provide engine the fuel atomized fuel. It also plays a role of storing high-pressure fuel to eliminate fuel pump resonance caused by pumping fuel. The fuel pressure remains stable. Fuel injector is an electromagnetic controlled nozzle. The return spring inside the shell compresses needle valve and seal the exit. During injection, the electronic controller gives control signal, electromagnetic coil obtains power, producing the magnetic field to overcome the return spring pressure, needle gravity, friction, etc. lift the needle valve. Under the pressure fuel sprays out. As the needle valve only has rising and falling only two states, needle lift travel can not be adjusted. As long as the pressure difference is constant, fuel injection quantity only depends on the needle valve opening time that is opening electrical pulse width.

Note

When the fuel injector is blocked or not closed tight, the engine malfunction lamp may be lit. The detected DTC code is: oxygen sensor distortion, signal erratic or Air-Fuel ratio is not normal etc. At this point, carefully diagnose the component fault. Because when the fuel injector is blocked, the fuel injection amount is not controlled by ECM fuel injection pulse width. The oxygen sensor mixture concentration signal feedback to ECM will very different from the theoretical value. ECM will determine the oxygen sensor is not working properly. The system can not determine whether it is the oxygen sensor itself faulty or other associated components faulty. Pay attention to determine the failure component when diagnose such a fault.

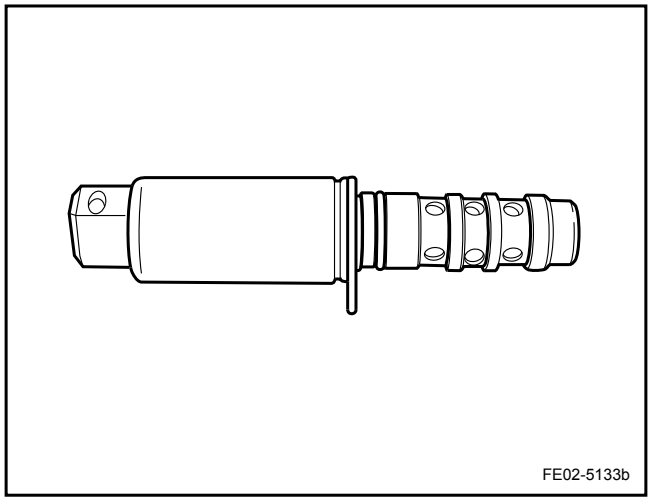
ECM controls the fuel injectors through ECM harness connector EN01 terminals No.50,63,49,64. If a fuel injector or circuit is fault, DTC code P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271 will be recorded.

3. Ignition Coil



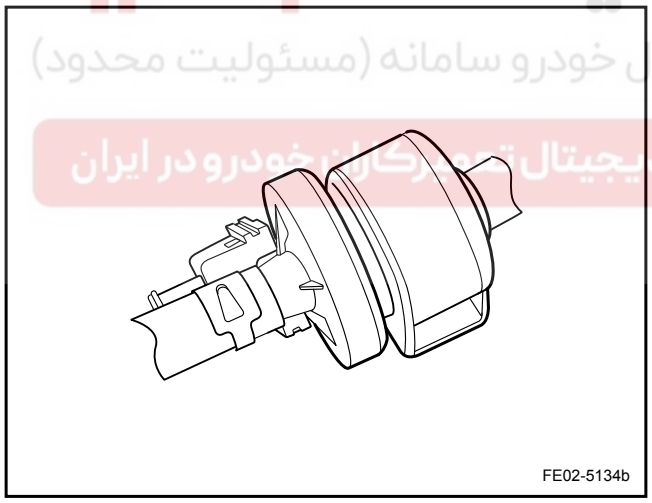

Cylinder No.1,4 ignition coil is located at top of the cylinder No. 4. Cylinder No.2,3 ignition coil is located at top of the cylinder No.2. Ignition coil primary winding low voltage will be transformed into the secondary winding high voltage. The spark plug discharges spark, igniting the air and fuel mixture inside the cylinder. Ignition coil consists of a primary winding, a secondary winding, iron core, shell and other components. When the primary winding is connected to ground, it will be charged. Once ECM cuts off the primary winding circuit, then charging will be terminated, while a high voltage induced in the secondary winding, so that spark plug discharges. Different from the ignition coil with a distributor, the ignition coil secondary winding is connected to a spark plug at each end, so the two spark plug discharge at the same time. ECM controls the ignition coil through ECM harness connector EN01 terminals No.3,7. When an ignition related fault occurs, DTC code P0300, P0301, P0302, P0303, P0304 will be recorded.

4. Variable Valve Timing Solenoid Valve (VVT)




VVT solenoid valve is located at the engine intake manifold side near the front. VVT magnetic valve is a 4-bit 4-pass solenoid valve, the working power supplied from main relay controlled by ECM. ECM controls VVT solenoid valve ground with a pulse width modulation signal. ECM controls VVT solenoid valve through ECM harness connector EN01 terminal No.2.

5. Canister Solenoid Valve (EVAP)

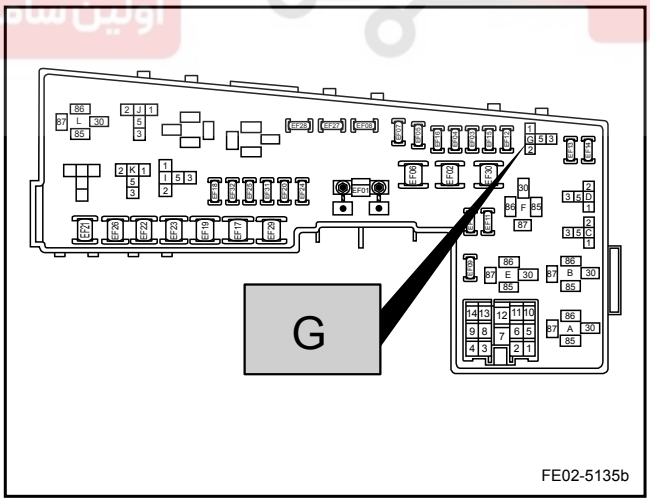



Canister control valve is located in the engine cylinder head cover side (transmission side) and is used to control the Canister clean air flow. ECM controls Canister valve according to engine load, engine temperature, speed and a series of signals. Through an integrated calculation, ECM gives electrical pulse duration and frequency (i.e. duty cycle) to control EVAP. Accumulated fuel vapor in the Canister, can cause environmental pollution once leaking. Canister solenoid valve is opened at the right time, so that the excessive fuel vapor after mixing with air entering into the intake manifold to participate in combustion. Canister control valve consists of the electromagnetic coils, armature and valves. Canister inlet port has a filter. On one hand, air flow through the Canister control valve is related to ECM to the Canister control valve output electrical pulse duty cycle, on the other hand, it is related to the pressure difference between the Canister inlet port and outlet port. When there is no electrical pulse, the Canister control valve is closed. According to the engine sensors provided signals, ECM controls the Canister solenoid valve power-on time, indirectly controls the air flow amount. When the engine coolant temperature, engine working hours, engine load, etc. meet the preset requirements, ECM will command Canister solenoid valve work. Under the following conditions, Canister will not work:

- Engine cold start.
- Engine coolant temperature is relatively low.
- Engine idling.
- Engine heavy load.
- Important system sensor malfunction.

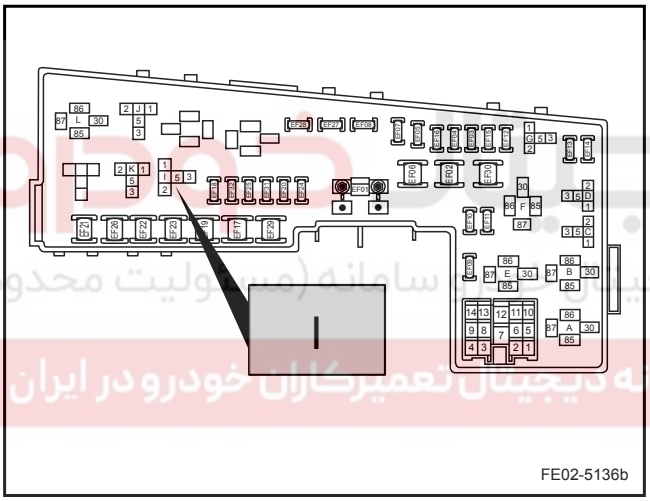
ECM controls Canister solenoid valve through ECM harness connector EN01 terminal No.37. When the EVAP solenoid valve and circuit are faulty, DTC code P0444, P0458 , P0459 will be recorded.

6. Main Relay



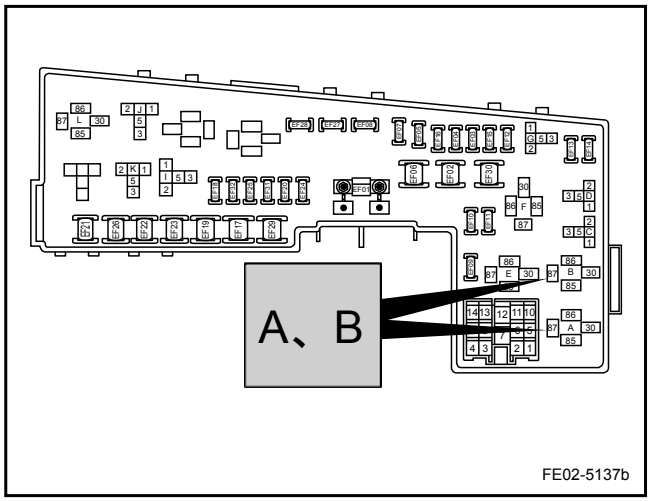
Main relay is controlled by ECM, when turning the ignition switch to "ON" position, battery voltage passes through the ignition switch to ECM 10 A fuse, and finally to ECM harness connector EN01 terminal No.17. ECM detects the terminal voltage, then controls the EN01 terminal No.32 to connect to ground. The main relay starts work and provides power to the Air-Conditioning compressor relay, cooling fan low speed relay, cooling fan high speed relay, pump relay, ECM wiring harness connector EN01 terminals No. 8 and 51, Canister solenoid valve, VVT solenoid valve, ignition coil, fuel injectors, Pre-Catalytic oxygen sensor heating, Post-Catalytic oxygen sensor heating and vehicle speed sensor. So when the main relay is not working properly, the engine will not work. ECM controls the main relay through ECM harness connector EN01 terminal No.32. ECM will not record the main relay associated DTC code.

### 7. Pump Relay (I) and Fuel Pump




Pump relay is located in the underhood fuse box. fuel pump is installed in the fuel tank. ECM controls fuel pump relay closing and the fuel pump work. The fuel pimp and the motor are installed on the same axle inside the housing, and surrounded by fuel, cooled and lubricated by fuel. As the pump relay pulls in, battery provides power through fuel pump relay to fuel pump. Only when fuel pump relay is working and the engine is running, the electric fuel pump circuit is connected. When the engine stops running due to an accident, the fuel pump automatically stops. The electric fuel pump export maximum pressure is determined by the pressure relief valve installed on the fuel pump. The export maximum pressure is between 450 kPa and 650 kPa. Fuel system uses "no-return pipe system", which stabilize fuel pressure at around 400 kPa. ECM controls fuel pump relay through ECM harness connector EN01 terminal No.61. If the pump relay and its circuit are faulty, DTC code P0627, P0628, P0629 will be recorded.

### 8. High-Speed Cooling Fan Relay (A), Low-Speed Cooling Fan Relay (B)




Two cooling fan relays are in underhood fuse box, mainly used to control the high-low speed cooling fan operation. ECM controls the Low-Speed cooling fan relay through ECM harness connector EN01 terminal No.62. ECM controls the High-Speed cooling fan relay through ECM harness connector EN01 terminal No.52. when the cooling fan relay and the circuit are faulty, DTC code P0480, P0481, P0691, P0692, P0694 will be recorded.

### 9. Air-Conditioning Compressor Relay

Air-Conditioning compressor relay is located in I/P fuse box, and is an internal integrated type. It is mainly used to control the electromagnetic compressor clutch work. ECM controls Air-Conditioning compressor relay through ECM harness connector EN01 terminal No.60. when the Air-Conditioning compressor relay and the circuit are faulty, DTC code P0645, P0646, P0647 will be recorded. If the relay is damaged, only replace the I/P fuse box.

### 10. CAN Information Output

ECM sends information to other modules with CAN signals through the CAN network, to achieve network sharing, the most typical signals are: TPS, ECT, engine speed signals and so on. CAN_H signal communicates with other CAN network modules through ECM harness connector EN01 terminal No.33. CAN_L signal communicates with other CAN network modules through ECM harness connector EN01 terminal No.34. If ECM communication with other modules fails, DTC code U0001, U0121, U0140, U0151, P1523 will be recorded.

11. Serial Data Cable Output

The most typical serial data cable output application is the information exchange with the Anti-theft module. Scan tool diagnosis, data flow reading and other operations are also through the serial data cable. ECM harness connector EN01 terminals No.15,23 are for serial data communication.

## 2.2.3 System Working Principle

### 2.2.3.1 System Working Principle

ECM calculates the basic fuel injection duration, Air-Fuel ratio close to the ideal mixture for the engine, and controls engine operation based on the engine's intake air quantity and engine speed signal. For example, in cold start, according to related signals, ECM increases the fuel injection and controls idle speed control valve actuator, to achieve a smooth start and controls the engine idle speed. In addition, ECM also has the fault self-diagnosis and protection function, when the engine fails, ECM can automatically diagnose and preserve the DTC code and, sends a warning through the fault indicator light. The stored code can appear again in certain trigger conditions. Once the sensor or actuator fail, ECM automatically start the backup system, to ensure the safety of the vehicle, maintain the vehicle driving ability. ECM can also communicate with scan tool. Scan tool can be used to read the stored DTC code and scan the current ECM operating system parameters, that is the data stream. Scan tool can also be used to drive the control system actuators for test, which provides a great convenience to diagnostic.

### 2.2.3.2 Fuel Injection Quantity Adjustment

At Startup, ECM calculates fuel injection time based on the engine speed, engine coolant temperature signal. After startup, ECM determines the basic fuel injection quantity based on the intake manifold absolute pressure sensor. After determining the basic fuel injection quantity, according to the different engine operating conditions, ECM adjusts the fuel injection as following:

- Start Up-Enrich Mixture: Starting condition is when the engine speed is below the specified value, the ignition switch is ON. Especially in the low temperature, in order to improve startup performance, ECM increases fuel injection time, and enriches the mixture.
- After Start-Enrich Mixture: The engine has just started, in order to maintain its running stability, ECM increases fuel injection amount according to the engine coolant temperature.
- Warm Up-Enrich Mixture: The engine temperature is low, gasoline evaporation is poor, ECM provides rich mixture. ECM increases fuel injection amount according to the engine coolant temperature.
- Heavy Load-Enrich Mixture: The engine power output is maximum, in order to ensure the engine work properly, ECM increases fuel injection duration according to throttle position, engine speed, air flow, engine coolant temperature signal. Increased fuel amount is up to 8% -30% of normal fuel injection amount.
- Acceleration-Enrich Mixture: When the engine is accelerating, for it to have dynamic, enrich the mixture. ECM increase the fuel injection amount according to air flow, engine speed, vehicle speed, throttle position (change rate), the engine coolant temperature sensor signal.
- Intake Air Temperature Adjustment: Air density changes as the temperature changes. In order to maintain a more accurate Air-Fuel ratio, ECM uses air density at 20°C (68 ºF) as the standard value. ECM adjusts fuel injection according to measured intake air temperature signal. At low temperature, ECM increases fuel injection amount. At high temperature, ECM decreases fuel injection amount. The adjustment is up to 10%.
- idle Stability Adjustment: In the engine control system, when the intake manifold pressure increase, the idle speed drops. ECM adjusts fuel injection amount according to throttle position, engine speed, intake manifold absolute pressure sensor signal.
- Air-Fuel Ratio Feedback Adjustment: ECM adjusts fuel injection amount according to oxygen sensor signal. When engine starts, the mixture will be enriched. With heavy load, the engine coolant temperature below the set temperature and fuel supply cut off operating conditions, ECM is in close-loop control mode.
- Cut Off Fuel Supply: In order to achieve good fuel economy, lower emissions pollution, when the engine is in forced idle state, ECM cut off fuel supply temporarily according to throttle position, engine speed, engine coolant temperature sensor signal. During emergency deceleration, engine over speed, vehicle over speed, fuel supply will also be cut off temporarily.
- Voltage Adjustment: Power supply voltage affects fuel injection amount. When voltage is low, the actual injection duration is shorter than normal and the mixture is lean. It needs to be adjusted. ECM adjusts fuel injection amount according to high or low voltage. Power supply voltage signal is from the battery.

### 2.2.3.3 Fault Self-Diagnostic and Protection Function

In order to discover the engine electronically controlled gasoline injection system fault in time, and maintain the vehicle basic driving ability when a fault occurs, ECM has a fault diagnostic and self-protection function. ECM is equipped with a dedicated self-diagnostic circuit. When the engine is running, ECM continuous monitors various parts. Once ECM detects an abnormal situation, it will store the fault signal in memory, and displays DTC code.

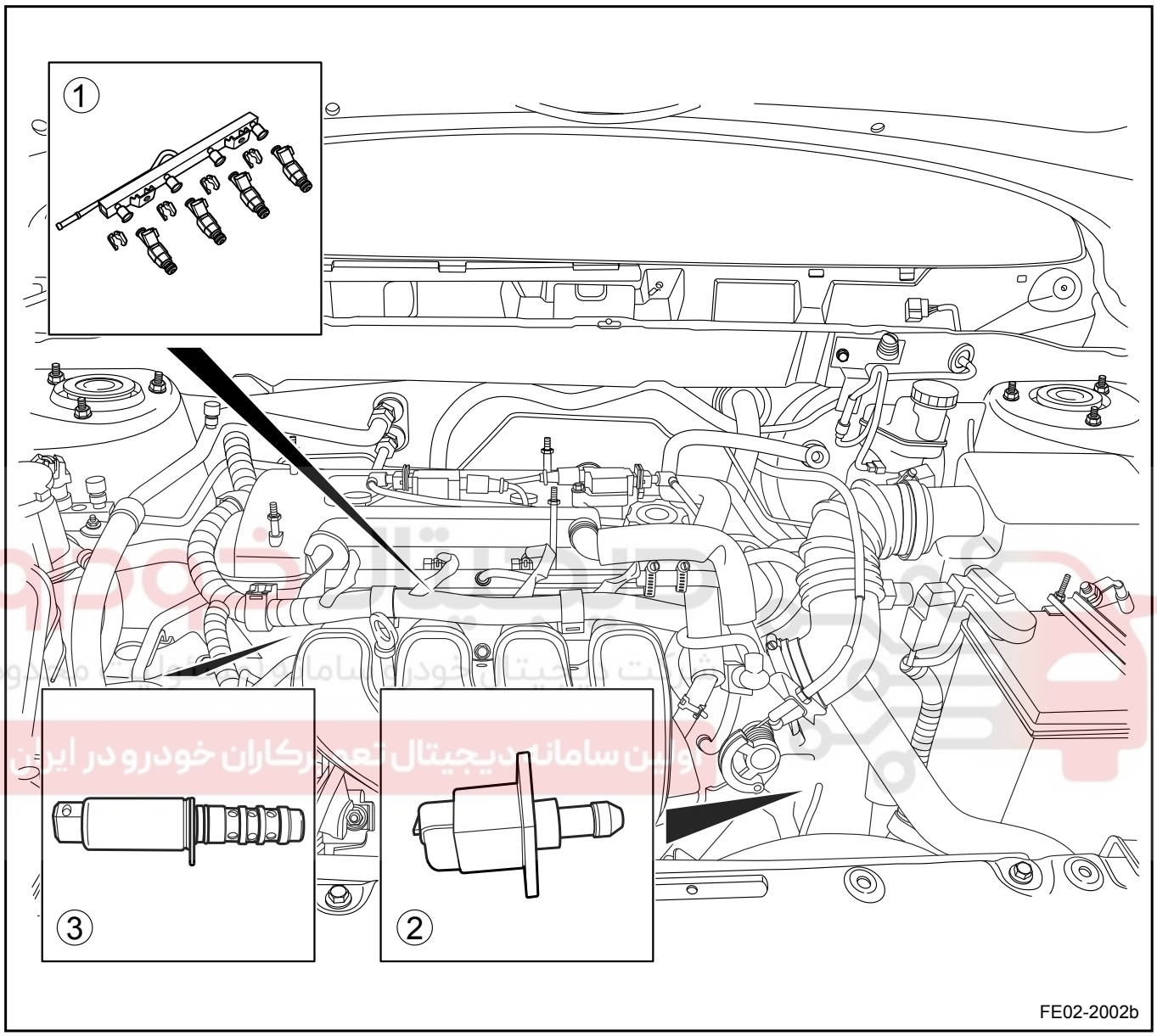
In order to prevent vehicle can not be driven due to the sensor malfunction. ECM uses pre-stored sensor signals to continue to control engine operation.

For actuators, in order to prevent their failure affect safety, ECM can take measures to ensure the engine safety. At this point, ECM will send out warning signals and stop fuel injection.

In addition, ECM is also equipped with an emergency circuit. When the emergency control circuit receives an abnormal signal, ECM will enable the backup program. The fuel injection amount and ignition timing will be controlled according to the original set-up program, to maintain the vehicle basic driving ability.

## 2.2.4 Component Locator

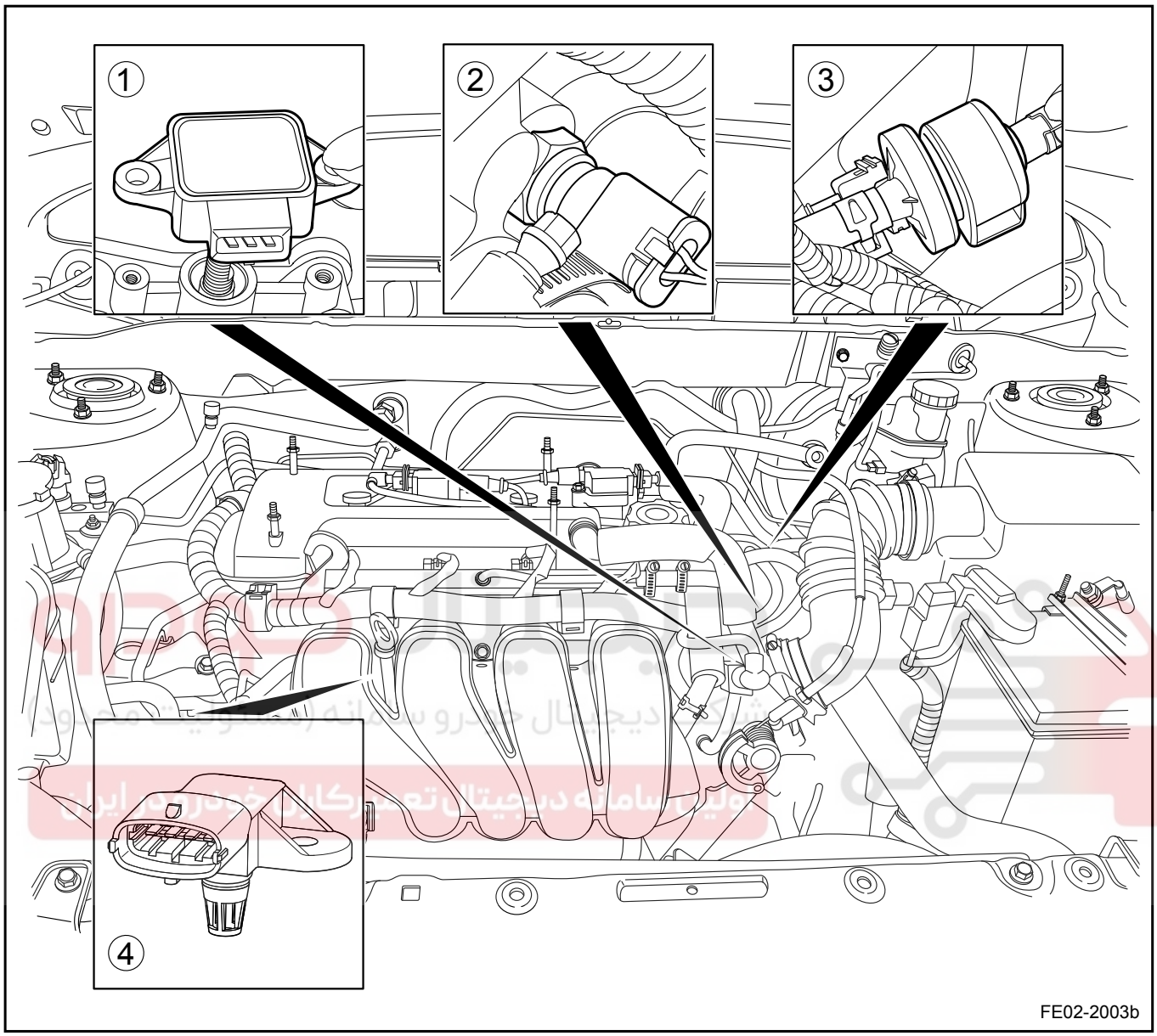
### 2.2.4.1 Fuel Injector, Idle Speed Control Valve and VVT Solenoid Valve




Legend

1. Fuel Rail Injector Subassembly
2. Idle Speed Control Valve
3. VVT Solenoid Valve

## 2.2.4.2 Throttle Position Sensor, Engine Coolant Temperature Sensor, Canister Solenoid Valve and Intake Air Pressure and Temperature Sensor

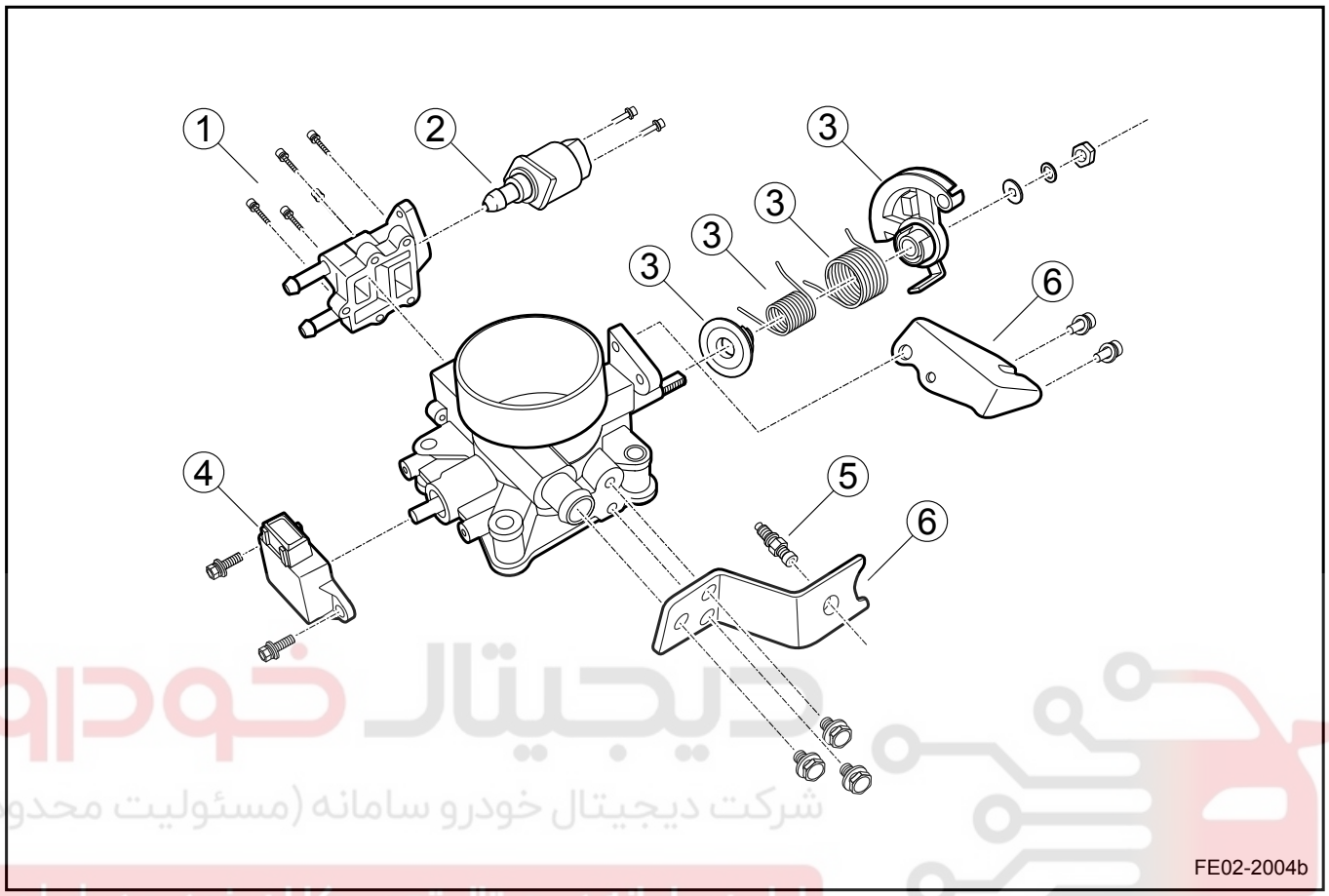



Legend

1. Throttle Position Sensor
2. Engine Coolant Temperature Sensor
3. Canister Solenoid Valve
4. Intake Air Pressure and Temperature Sensor

## 2.2.5 Disassemble View

### 2.2.5.1 Throttle Body Assembly

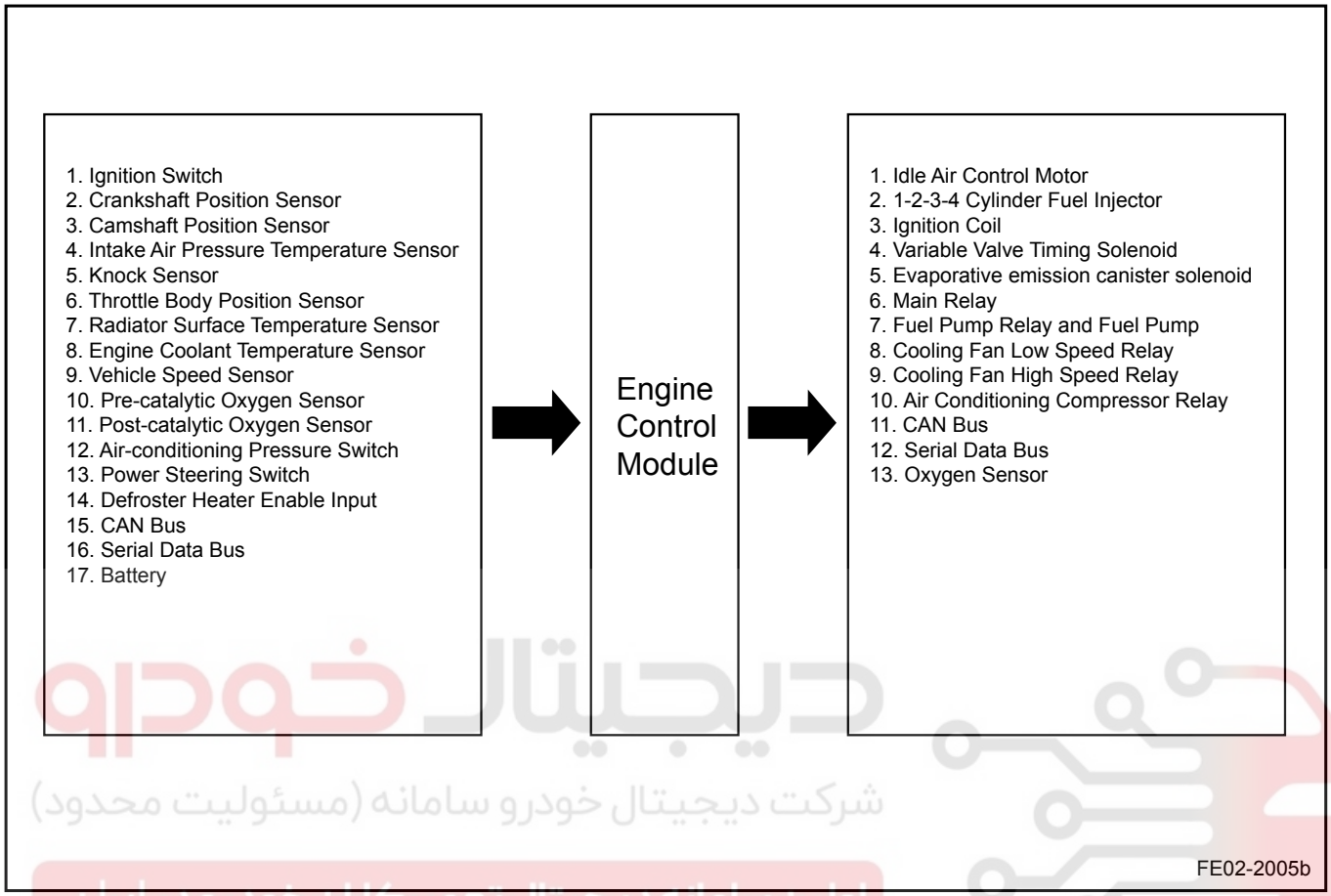


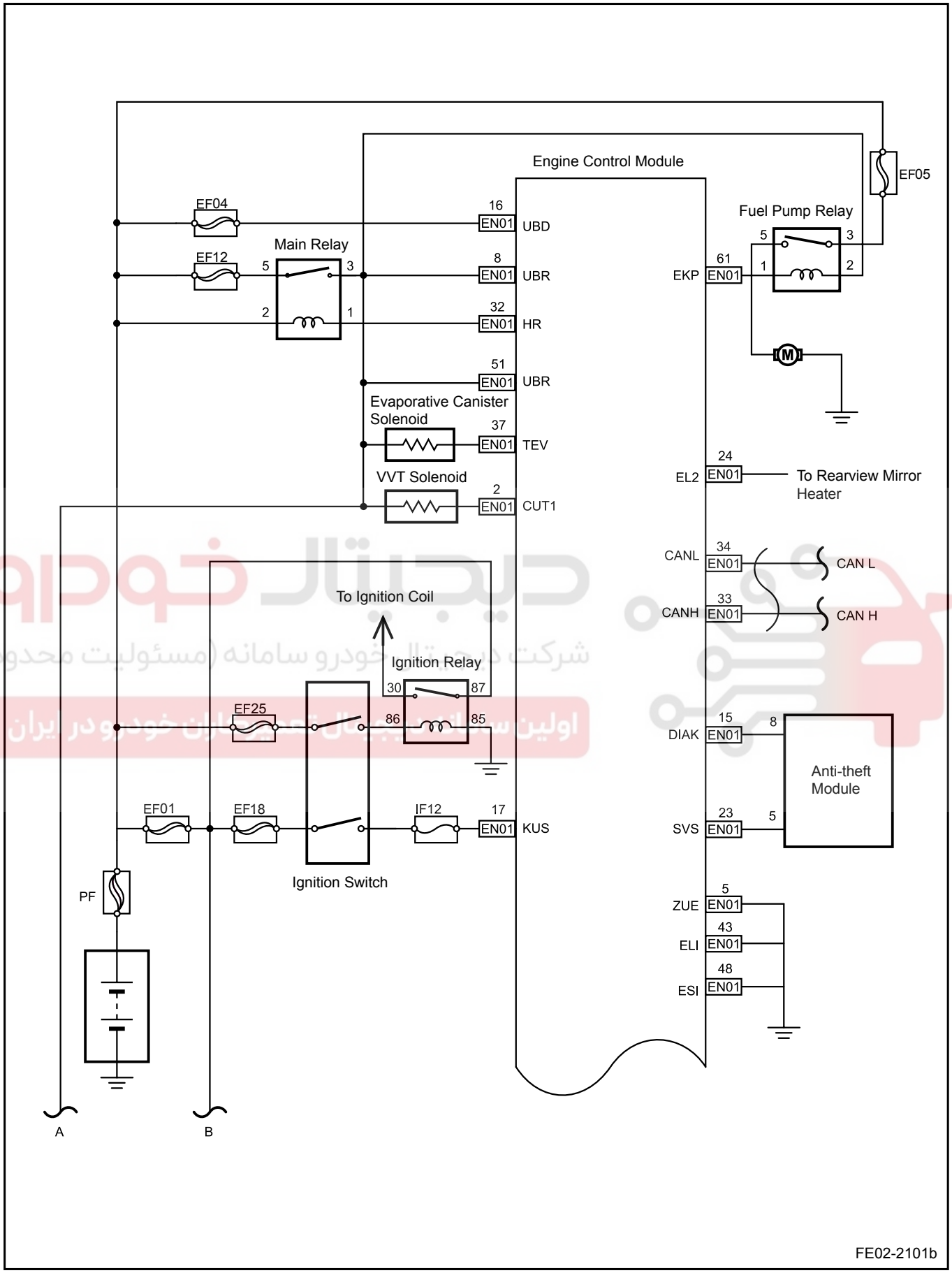

Legend

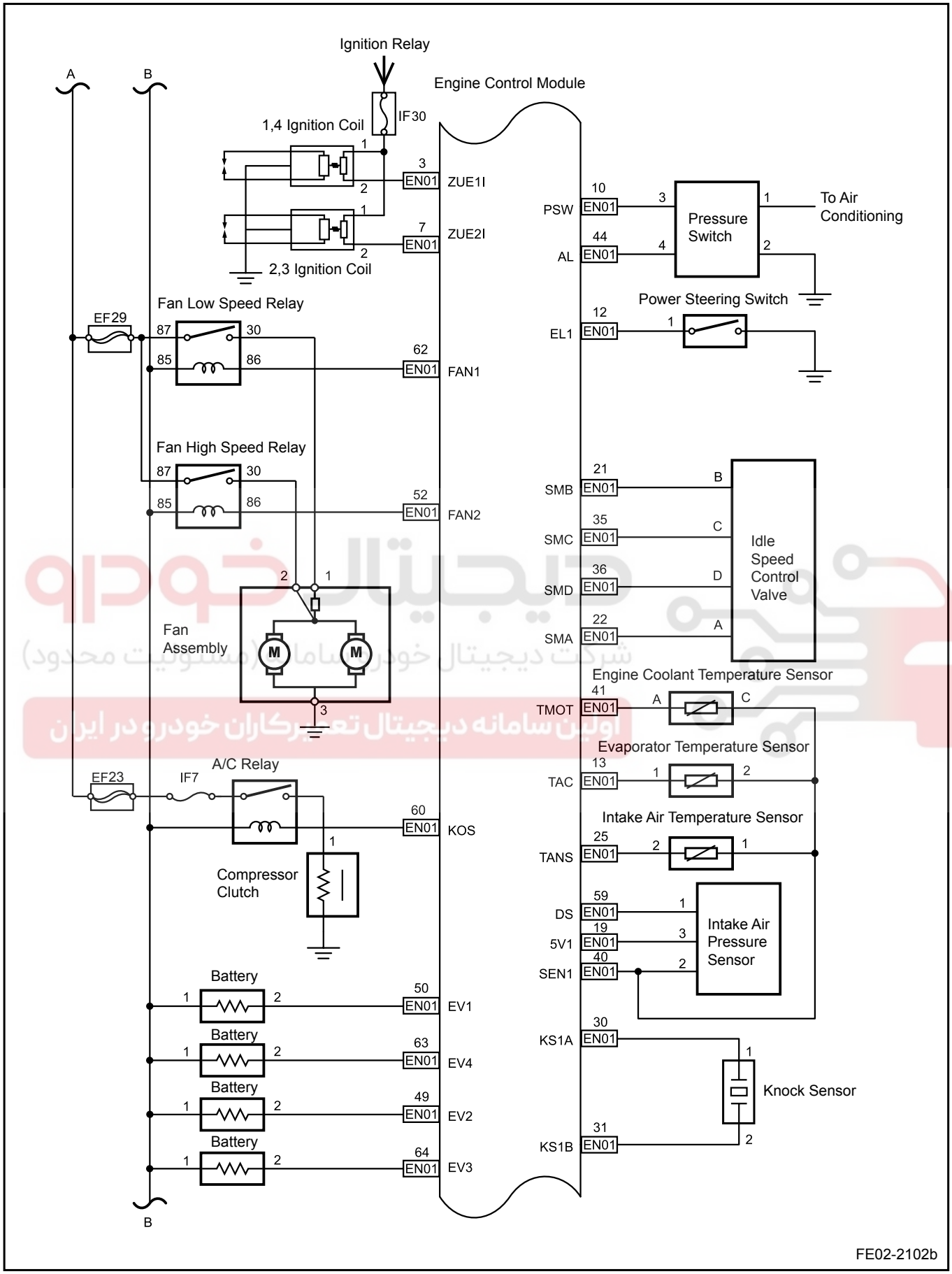
1. Idle Air Intake Channel
2. Idle Speed Control Valve
3. Throttle Butterfly Valve Control Components
4. Throttle Position Sensor
5. Throttle Limit Screw
6. Throttle Cable Mounting Bracket

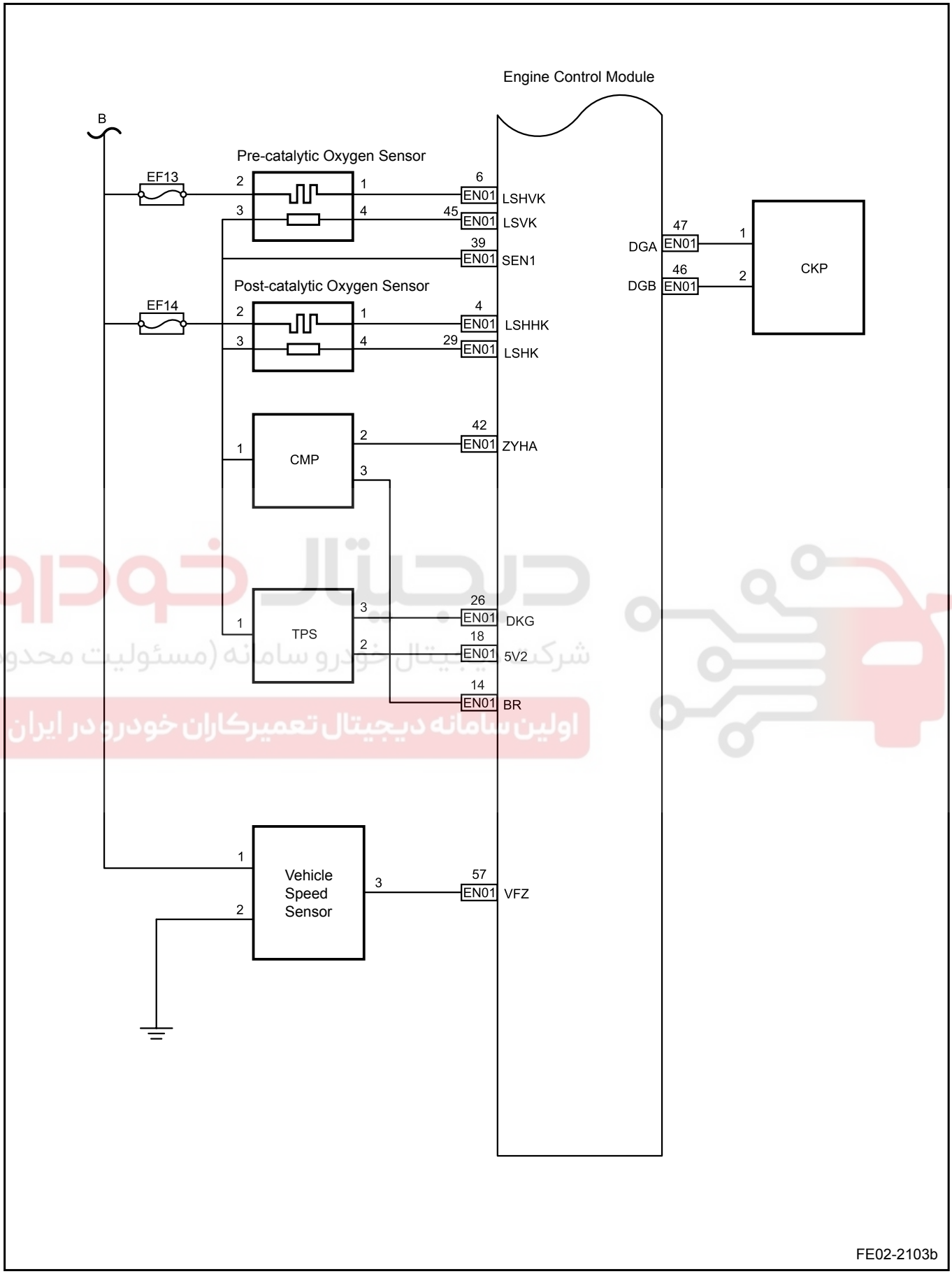
## 2.2.6 Schematic

### 2.2.6.1 Schematic









## 2.2.7 Diagnostic Information and Procedures

### 2.2.7.1 Diagnostic Description

Before diagnose the control system, please refer to 2.2.2.1 Overview and 2.2.3.1 System Working Principle. Understand and become familiar with control system working principle and then start systematic diagnosis, so that in the event of faults it will help determine the correct Diagnostic Steps, more importantly, it will also help to determine whether the customer described situation is normal or not.

Any control system fault diagnosis should start with "Control System Check" as a starting point. "Control System Check" will guide the service personnel to take the next logical step to diagnose the fault. Understand and the correct use of diagnostic flow charts can reduce diagnostic time and avoid misjudging a component.

### 2.2.7.2 Control System Check

Before the control system check, please do following preliminary checks:

1. Check the battery terminal voltage to ensure an adequate power supply and a stable voltage.
2. Check the battery cables, clean and tighten.
3. Check the easy to access system components whether there are obvious damages that may cause the symptoms, such as vacuum tube damage and the reliability of wiring harness connectors connection.
4. Check control module and battery ground points whether there are copper oxidizing or signs of loosening.
5. Check control system whether it is likely to affect the normal system operation after the installation of aftermarket equipments.

Diagnostic Steps:

| | |
|---|---|
| Step 1 | Verify customer described faults. |

Next

| | |
|---|---|
| Step 2 | Connect a scan tool. |

(a) Install the scan tool.
(b) Turn on the scan tool.
Is the scan tool connected?

No → Go to step 11

Yes

| | |
|---|---|
| Step 3 | Start communication between the scan tool and the engine control module. |

(a) Turn the ignition switch to "ON", but do not Start the engine.
(b) Try to establish communication between the scan tool and engine control module (ECM) .
Can the scan tool communicate with engine control module?

No → Go to step 14

Yes

| | |
|---|---|
| Step 4 | Start the engine and run at idle speed. Can the engine start? |

No → Refer to 2.11.7.4 Engine Can Not Start

Yes

| | |
|---|---|
| Step 5 | Select engine control module DTC code reading function. Is there any system DTC code? |

No → Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 6 | Record and clear the DTC code. |

Next

| | |
|---|---|
| Step 7 | Verify fault symptoms. |

| Results | To Step |
|---|---|
| Fault does not appear. | Yes |
| Fault appears. | No |

No → Go to step 9

Yes

| | |
|---|---|
| Step 8 | Simulate fault symptoms. |

Next

| | |
|---|---|
| Step 9 | Check control system whether there is a DTC code. |

| Results | To Step |
|---|---|
| DTC Code | Yes |
| No DTC Code | No |

No → Refer to 2.5.7.6 Fault Symptom Table

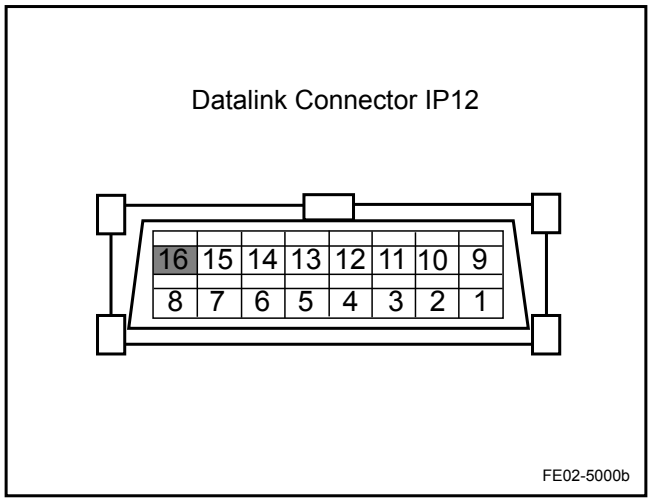
Yes

| | |
|---|---|
| Step 10 | Repair according to the DTC code. Refer to 2.2.7.11 DTC Code Index. |
| Step 11 | Connect the scan tool to a proper operated vehicle. Can the scan tool be turned on? |

No → The scan tool failed. Replace the scan tool.

Yes

| | |
|---|---|
| Step 12 | Check datalink connector power supply circuit. |




(a) Turn the ignition switch to "ON" position.
(b) Measure the voltage between datalink connector IP12 terminal 16 and a reliable ground.

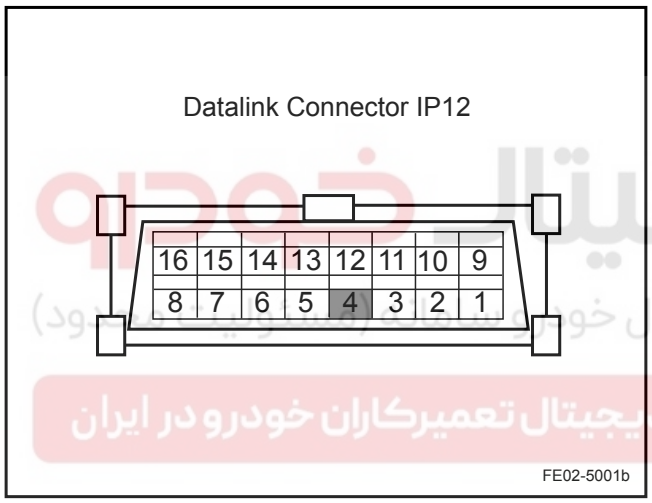
Standard Voltage: 11-14 V

Is the voltage normal?

No → Check if the circuit between terminal 16 and the IF21 fuse open.

Yes

| | |
|---|---|
| Step 13 | Check datalink connector ground circuit. |




(a) Turn the ignition switch to "OFF" position.
(b) Measure the voltage between datalink connector IP12 terminal 4 and a reliable ground.

Standard Resistance: Less than 1 Ω

No → Check if the circuit between terminal 4 and the ground open.

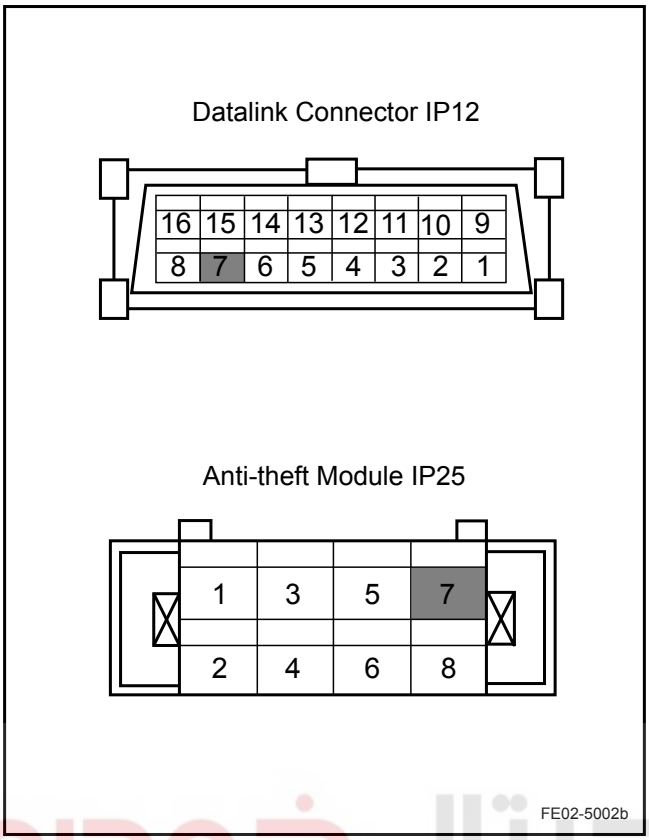
Yes

| | |
|---|---|
| Step 14 | Is the engine running properly? |

No → Engine immobilizer control module and ECM communication failure, check and repair the relevant components. Refer to 2.5.7.12 Engine Anti-theft Warning Lamp Flashing, Vehicle Can Not Start

Yes

| | |
|---|---|
| Step 15 | Terminal continuity check. |




(a) Disconnect engine immobilizer control module IP25 wiring harness connector.

(b) Test the terminal continuity using an ohmmeter.

| Connecting Multimeter | Standard Value |
|---|---|
| IP12(7) - IP25(7) | Less than 1 Ω |

(c) Reconnect the engine immobilizer control module IP25 wiring harness connector.

Normal?

No → Repair or replace the wiring harness connector.

Yes

| | |
|---|---|
| Step 16 | Test to confirm. |

Next

| | |
|---|---|
| Step 17 | End. |

## 2.2.7.3 Intermittent Fault Check

### Note

1. Clear DTC.
2. Carry out simulation tests.
3. Inspect and shake the wiring harnesses, connectors and terminals.

When DTC checks can not identify the fault, the fault occurs only occasionally in use. At this point you should test and confirm all circuits and components that can possibly lead to the fault. In many cases, carrying out the basic checks flow chart shown in the following can quickly and efficiently identify the Repair the faulty part. especially for harness connector poor contact.

Fault Definition: The fault currently does not appear, but the historical record indicates that the fault has appeared before. Or a customer reported the fault and had it repaired, but because the fault is not relevant to the DTC code, the fault symptoms do not appear.

Diagnostic Steps:

| | |
|---|---|
| Step 1 | Is the battery voltage normal? |

(a) Turn the ignition switch to "OFF" position.

(b) Measure the battery voltage with a multimeter.

According to the Measure value, choose the appropriate diagnostic step.

| Results | To Step |
|---|---|
| 11 V or higher | Yes |
| Less than 11 V | No |

No → Check the battery. Refer to 2.11.2.1 Battery Description and Operation

Yes

| Step 2 | Check visually and physically. |
|---|---|

This step is an important method to initially identify the fault location:

(a) Check wiring harness for damage, wear and tear.
(b) Check whether the wiring harness routed properly. Do not place wiring harness near a device with high voltage or high current running through:
- Such as start motor, generator and other motor components. When these components are working, they will introduce great electromagnetic interference, thus affecting the proper signal transmission, resulting in system not working properly.
- Ignition coil, ignition wires and other components.

(c) Check whether there is a vacuum hose cracking, damage or distortion. Confirm the hoses correct connection and routing.
(d) Check whether there is air intake system leak, for example, throttle body installation surface, idle speed control valve, intake manifold sealing surface and so on.
(e) Check the engine control module (ECM) ground and the body ground whether there is oxidation, loose, incorrect position. The control system ground can not be changed at will, as this will affect the proper operation of the control system .
(f) Check whether the battery positive and negative cable connections are reliable, whether there is loose, oxidation, corrosion and so on.

Next

| Step 3 | Check wiring harnesses and connectors. |
|---|---|

(a) Many intermittent faults are caused by vibration, distortion, uneven roads, improper operation of components or connectors dislocation.
(b) If the circuit resistance is too high, it may result in components not working properly. Use a scan tool to drive the actuators, if not working, check whether the resistance in the circuit is too high or other faults.

Next

| | |
|---|---|
| Step 4 | Reproduce the fault and use instruments to record engine control module data. |

(a) Connect a scan tool and use the data record function to record road test data. After pressing the vehicle data recorder button, the scan tool can record engine control module data in the event of intermittent fault occurring, and then the data can be used to identify the fault location.

(b) Another diagnostic method is when the vehicle is driven connect a digital multimeter to the suspicious circuit. Digital multimeter abnormal readings may indicate the fault location.

Next

| | |
|---|---|
| Step 5 | Intermittent malfunction indicator light, but a DTC code is not set in the system. |

Following conditions may cause intermittent malfunction indicator light, but the system does not set the DTC codes:

(a) Relay working abnormally, the engine control module controlled electromagnetic valves or switches causing electromagnetic interference.

(b) Non-original or aftermarket accessories, such as a phone, alarm, lights or radio equipment, not installed properly.

(c) Intermittent malfunction indicator light control circuit short to ground.

(d) Engine control module ground loose.

Next

| | |
|---|---|
| Step 6 | Other checks. |

(a) Test whether Air-Conditioning compressor clutch diodes at both ends and other diodes are in open circuit.

(b) Check charging system whether there are following conditions existing:

- Generator rectifier fault within the electrical system may result in the communication signal interference.
- Generator output voltage is correct or not. If the generator output voltage is lower than 9V or higher than 18V, repair the charging system.

Next

| | |
|---|---|
| Step 7 | Refer to fault symptom table. |

## 2.2.7.4 Fault Symptom Table

If a fault occurred, but no DTC code stored within ECM, or the fault cause can not be identified in the basic checks, you should diagnose or exclude the fault based on the sequence listed in the following table.

| Symptoms | Suspected Fault Items | Relevant Sections |
|---|---|---|
| Engine does not run. | 1. Battery | "Starting/Charging System" in the2.11.7 Diagnostic Information and Procedures. |

| Symptoms | Suspected Fault Items | Relevant Sections |
|---|---|---|
| Fault Definition: When the ignition switch in the "ST" position, the engine crankshaft is not rotating. | 2. Starter | |
| | 3. Start Relay | |
| | 4. Ignition Switch | |
| | 5. BCM | "Engine Immobilizer System" in the2.5.7 Diagnostic Information and Procedures. |
| | 6. Engine Immobilizer System | |
| Engine does not start, no sign of the vehicle starting.<br>Fault Definition: When ignition switch in the "ST" position, the engine crankshaft rotates, but no sign of the vehicle starting. | 1. ECM Power Supply Circuit | This section2.2.7.37 DTC P0560 P0562 P0563. |
| | 2. Crankshaft Position Sensor | This section2.2.7.29 DTC P0321 P0322. |
| | 3. Camshaft Position Sensor | This section2.2.7.31 DTC P0340-P0343. |
| | 4. Ignition System | "Ignition System" in the2.10.7 Diagnostic Information and Procedures. |
| | 5. Fuel Pump Control Circuit | "Fuel System" in the2.3.7 Diagnostic Information and Procedures. |
| | 6. Fuel Injector Working Circuit | |
| | 7. ECM | This section2.2.8.8 Engine Control Module Replacement. |
| Engine difficult to start<br>Fault Definition: The engine crankshaft rotation is normal, but the vehicle can not be started in a long time. The engine is eventually started, but it may stop immediately. | 1. ECM Power Supply Circuit | This section2.2.7.37 DTC P0560 P0562 P0563. |
| | 2. Engine Coolant Temperature Sensor | This section2.2.8.6 Engine Coolant Temperature Sensor Replacement. |
| | 3. Idle Air Control Valve (IAC) System | This section2.2.8.1 Idle Air Control Valve Replacement. |
| | 4. Fuel Pump Relay, Fuel Pump, Fuel Injector, Fuel Contamination | "Fuel System" in the2.3.7 Diagnostic Information and Procedures. |
| | 5. Ignition System: Ignition Wire, Spark Plug, Ignition Coil | "Ignition System" in the2.10.7 Diagnostic Information and Procedures. |
| | 6. Excessive Engine Oil in Combustion Chamber and Valve Seal Leakage | "Mechanical System" in the2.6.7 Diagnostic Information and Procedures. |
| | 7. Excessive Carbon Residue in Combustion Chamber | |
| | 8. Incorrect Assembly | |
| | 9. Incorrect Cylinder Compression Pressure | |
| Poor idle, Unstable, Inaccurate or Stall<br>Fault Definition: Engine running unstable during idle. In extreme cases, the engine or the vehicle will tremble. With the throttle opening at a certain | 1. ECM Power Supply Circuit | This section2.2.7.37 DTC P0560 P0562 P0563. |
| | 2. Air Cleaner Filter Blocked | --- |
| | 3. Fuel Pressure Abnormal | "Fuel System" in the2.3.7 Diagnostic Information and Procedures. |
| | 4. Fuel Contamination | |
| | 5. Injector Working Abnormal | |

| Symptoms | Suspected Fault Items | Relevant Sections |
|---|---|---|
| degree the engine idle speed may fluctuate. Any of above circumstance is likely serious enough to make the engine stall. | 6. Idle Air Control Valve | This section2.2.8.1 Idle Air Control Valve Replacement. |
| | 7. Crankcase Ventilation Valve | "Auxiliary Emissions Control Device" in the2.4.6 Diagnostic Information and Procedures. |
| | 8. Evaporative Emission (EVAP) Canister Solenoid Valve | "Auxiliary Emissions Control Device" in the2.4.6 Diagnostic Information and Procedures. |
| | 9. Knock Sensor (KS) System Ignition Delay | Ignition System "in the2.10.7 Diagnostic Information and Procedures |
| | 10. Spark Plug: Incorrect thermal value, damp, crack, incorrect gap, excessive erosion, excessive carbon residue and contaminated by fuel | |
| | 11. Spark Plug Wire Damage | |
| | 12. Ignition Coil Damage | |
| | 13. Crankshaft Position Sensor | This section2.2.7.29 DTC P0321 P0322. |
| | 14. Excessive Engine Oil in Combustion Chamber or Valve Seals Leakage | "Mechanical System" in the2.6.7 Diagnostic Information and Procedures. |
| | 15. Incorrect cylinder compression pressure | |
| | 16. Valve Stagnant or Leaking, Valve Spring Broken, Incorrect Valve Timing | |
| | 17. Excessive Carbon Residue in Combustion Chamber | |
| | 18. Electromagnetic interference (EMI) in voltage circuit may lead to engine Misfire. Use the scan tool to monitor the engine speed to detect electromagnetic interference. Engine speed parameter sudden increase while the actual engine speed is almost no change indicates presence of electromagnetic interference. If there is fault, check whether there is a high voltage part in the vicinity of the ignition control circuit. | --- |
| | 19. Check engine mountings. | "Engine Mechanical System" in the2.6.8.7 Engine Mount Replacement. |
| Engine stalls only when Air-Conditioning is working. Fault Definition: when Air-Conditioning is working, | 1. Air-Conditioning signal circuit | "Air-Conditioning System" in the8.2.7 Diagnostic Information and Procedures. |
| | 2. Idle Air Control Valve Stagnant | This section2.2.8.1 Idle Air Control Valve Replacement. |

| Symptoms | Suspected Fault Items | Relevant Sections |
|---|---|---|
| engine speed is not stable or engine stall. | 3.ECM | This section2.2.8.8 Engine Control Module Replacement. |
| Back fire, Pinging<br>Fault Definition: Unburned gases from the combustion chamber entering into the intake manifold or exhaust system, ignited, producing a very loud pinging sound. | 1.ECM Power Supply Circuit | This section2.2.7.37 DTC P0560 P0562 P0563. |
| | 2. Fuel Pressure Abnormal | "Fuel System" in the2.3.7 Diagnostic Information and Procedures. |
| | 3. Fuel Contamination | |
| | 4. Injector Working Abnormal | |
| | 5. Air leakage in intake system and crankcase | "Auxiliary Emissions Control Devices" in the2.4.6 Diagnostic Information and Procedures. |
| | 6. Crankcase Ventilation Valve | |
| | 7. Knock sensor (KS) system ignition delay too great | "Ignition System" in the2.10.7 Diagnostic Information and Procedures. |
| | 8. Spark Plug: Thermal Value Incorrect, Damp, Crack, Gap Incorrect, Excessive Erosion, Excessive Carbon Residue, Contaminated by Fuel | |
| | 9. Spark Plug Wire Damage | |
| | 10. Ignition Coil Damage | "Ignition System" in the2.10.7 Diagnostic Information and Procedures. |
| | 11. Engine coolant level too low, thermostat failure | "Engine Cooling System" in the2.8.7 Diagnostic Information and Procedures. |
| High Fuel Consumption, Poor Fuel Economy<br>Fault Definition: The actual road test fuel consumption is significantly higher than expected. In addition, the fuel consumption is also significantly higher than the previous road test. | 1.ECM Power Supply Circuit | This section2.2.7.37 DTC P0560 P0562 P0563. |
| | 2.<br>• Air-Conditioning or Defroster Always On<br>• Tire Pressure Incorrect<br>• Vehicle Overload<br>• Accelerate too fast, too frequent | --- |
| | 3. Air Cleaner Filter Blocked | --- |
| | 4. Poor Fuel Quality, Fuel Contamination | "Fuel System" in the2.3.7 Diagnostic Information and Procedures. |
| | 5. Fuel Pressure Abnormal | |
| | 6. Injector Working Abnormal | |
| | 7. Throttle Body Dirty | "Engine Mechanical System" in the2.6.8.5 Throttle Body Assembly Replacement. |
| | 8. Rich Gas and Air Mixture | This section2.2.7.21 DTC P0130 P0131 P0132 P0133 P0134 P2195 P2196. |

| Symptoms | Suspected Fault Items | Relevant Sections |
|---|---|---|
| | 9. Air Leakage In Intake System and Crankcase System | "Auxiliary Emissions Control Devices" in the2.4.6 Diagnostic Information and Procedures. |
| | 10. Crankcase Ventilation Valve Stagnant | |
| | 11. Knock Sensor (KS) system ignition delay too great | "Ignition System" in the2.10.7 Diagnostic Information and Procedures. |
| | 12. Spark Plug: Thermal Value Incorrect, Damp, Crack, Gap Incorrect, Excessive Erosion, Excessive Carbon Residue, Contaminated by Fuel | |
| | 13. Spark Plug Wire Damage | |
| | 14. Ignition Coil Damage | |
| | 15. Engine coolant level too low, thermostat failure | "Engine Cooling System" in the2.8.7 Diagnostic Information and Procedures. |
| | 16. Excessive engine oil in combustion chamber or valve seals leak | "Engine Mechanical System" in the2.6.7 Diagnostic Information and Procedures. |
| | 17. Cylinder Compression Pressure Incorrect | |
| | 18. Valve stagnant or leak, broken valve spring, valve timing incorrect | |
| | 19. Excessive Carbon Residue in Combustion Chamber | |
| | 20. Vacuum Hose Cracking or Kink, Connection Unreliable | |
| | 21. Exhaust not Smooth: Three-way Catalytic Converter Plug, Muffler Internal Damage | "Engine Exhaust System" in the2.7.5 Diagnostic Information and Procedures. |
| | 22. Braking System Dragging or Operation Abnormal | "Braking System" in the6.4.4 Diagnostic Information and Procedures. |
| | 23. Electromagnetic Interference (EMI) in the voltage circuit may lead to engine Misfire. Use the scan tool to monitor the engine speed to detect electromagnetic interference. Engine speed parameters sudden increase while the actual engine speed is almost no change indicates the presence of electromagnetic interference. If there is a fault, check whether there is a high voltage part in the vicinity of the ignition control circuit. | --- |

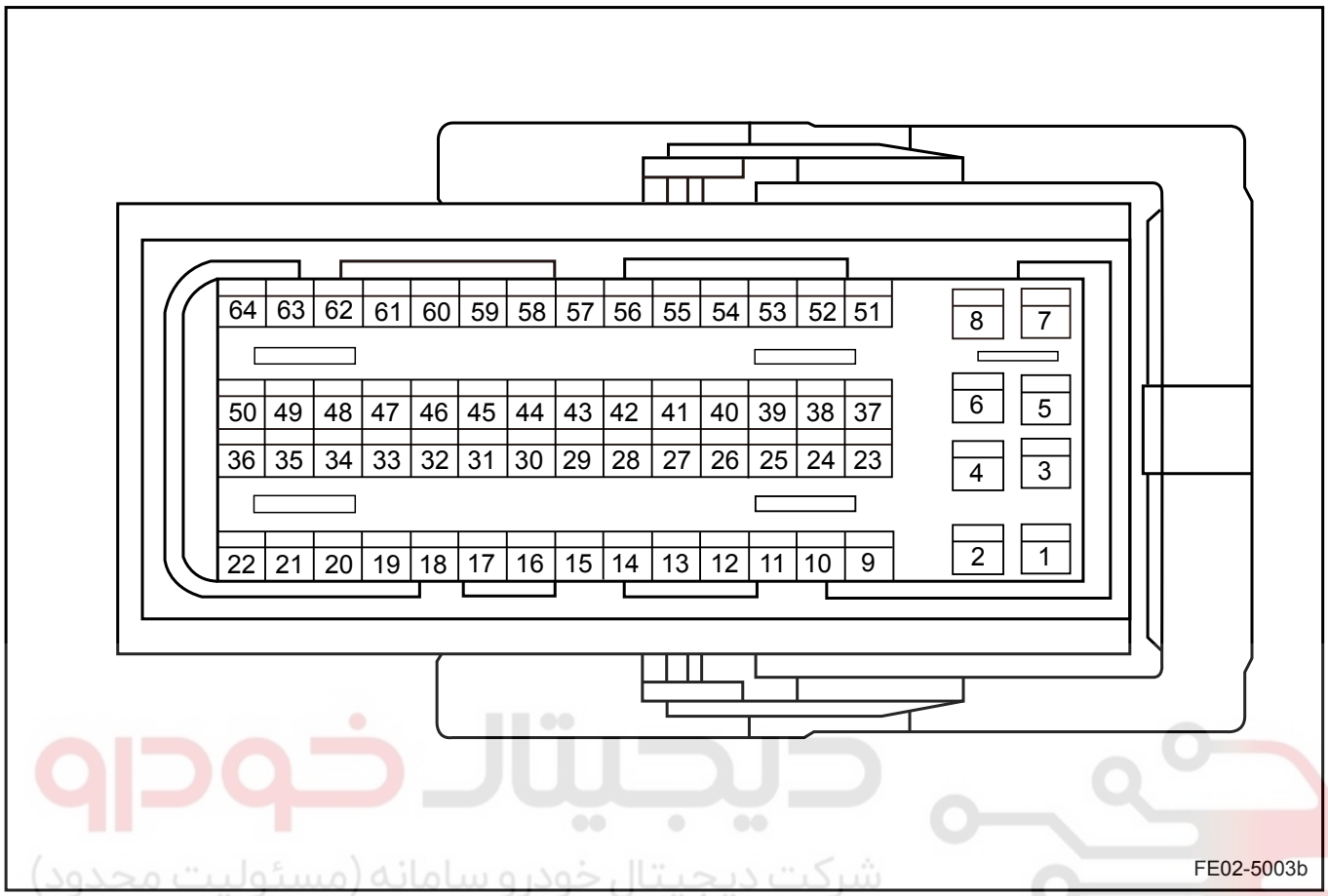
| Symptoms | Suspected Fault Items | Relevant Sections |
|---|---|---|
| Surge<br>Fault Definition: When the throttle position is stable the engine power changes. It feels as if the vehicle speed will rise and fall when there is no accelerator pedal position change. | 1. ECM Power Supply Circuit | This section2.2.7.37 DTC P0560 P0562 P0563. |
| | 2. Air-conditioner Compressor | "Air-Conditioning System" in the8.2.7 Diagnostic Information and Procedures. |
| | 3. Heated Oxygen Sensor Abnormal | This section2.2.7.37 DTC P0560 P0562 P0563. |
| | 4. Poor Fuel Quality, Fuel Contamination | "Fuel System" in the2.3.7 Diagnostic Information and Procedures. |
| | 5. Fuel Pressure Abnormal | |
| | 6. Injector Working Abnormal | |
| | 7. The Air-Fuel Mixture Too Rich | This section2.2.7.21 DTC P0130 P0131 P0132 P0133 P0134 P2195 P2196. |
| | 8. The Air-Fuel Mixture Too Lean | This section2.2.7.21 DTC P0130 P0131 P0132 P0133 P0134 P2195 P2196. |
| | 9. Spark Plug: Thermal Value Incorrect, Damp, Crack, Gap Incorrect, Excessive Erosion, Excessive Carbon Residue, Contaminated by Fuel | "Ignition System" in the2.10.7 Diagnostic Information and Procedures. |
| | 10. Spark Plug Wire Damage | |
| | 11. Ignition Coil Damage | |
| | 12. Intelligent Variable Valve Timing System | "Engine Mechanical System" in the2.3.7 Diagnostic Information and Procedures. |
| | 13. Vacuum Hose Cracking or Kink, Connection Unreliable | |
| Power Shortage, Accelerate Pedal Stagnant or Soft to Press<br>Fault Definition: The engine power output is lower than expected. When half-pressing the accelerator pedal, the vehicles accelerates a little or does not accelerate at all. | 1. ECM Power Supply Circuit | This section2.2.7.37 DTC P0560 P0562 P0563. |
| | 2. Air Cleaner Filter Blocked | --- |
| | 3. Poor Fuel Quality, Fuel Contamination | "Fuel System" in the2.3.7 Diagnostic Information and Procedures. |
| | 4. Fuel Pressure Abnormal | |
| | 5. Injector Working Abnormal | |
| | 6. The Air-Fuel Mixture Too Rich | This section2.2.7.21 DTC P0130 P0131 P0132 P0133 P0134 P2195 P2196. |
| | 7. The Air-Fuel Mixture Too Lean | |
| | 8. Knock Sensor (KS) System Ignition Delay Too Great | "Ignition System" in the2.10.7 Diagnostic Information and Procedures. |
| | 9. Spark Plug: Thermal Value Incorrect, Damp, Crack, Gap Incorrect, Excessive Erosion, Excessive Carbon Residue, Contaminated by Fuel | "Ignition System" in the2.10.7 Diagnostic Information and Procedures. |
| | 10. Spark Plug Wire Damage | |
| | 11. Ignition Coil Damage | |

| Symptoms | Suspected Fault Items | Relevant Sections |
|---|---|---|
| | 12. Crankshaft Position Sensor | This section2.2.7.29 DTC P0321 P0322. |
| | 13. Excessive Engine Oil in Combustion Chamber or Valve Seals Leakage | "Engine Mechanical System" in the2.6.7 Diagnostic Information and Procedures. |
| | 14. Cylinder Compression Pressure Incorrect | |
| | 15. Valve Stagnant, Valve Spring Broken, Valve Timing Incorrect | |
| | 16. Excessive Carbon Residue in Combustion Chamber | |
| | 17. Intelligent Variable Valve Timing System | |
| | 18. Exhaust Not Smooth: Three-way Catalytic Converter Plug, Muffler Internal Damage | "Engine Exhaust System" in the2.7.5 Diagnostic Information and Procedures. |
| Pinging, Knocking<br>Fault Definition: The knocking sound increases during acceleration. With the throttle opening changes, the engine will produce a sharp metal knocking sound. | 1. ECM Power Supply Circuit | This section2.2.7.37 DTC P0560 P0562 P0563. |
| | 2. Wrong Fuel Used | "Fuel System" in the2.3.7 Diagnostic Information and Procedures. |
| | 3. Fuel Pressure Abnormal | |
| | 4. Injector Working Abnormal | |
| | 5. The Air-Fuel Mixture Too Lean | This section2.2.7.21 DTC P0130 P0131 P0132 P0133 P0134 P2195 P2196. |
| | 6. Knock Sensor (KS) System Ignition Advance Too Great | "Ignition System" in the2.10.7 Diagnostic Information and Procedures. |
| | 7. Spark Plug Thermal Value Incorrect | |
| | 8. Engine Cooling System: Engine coolant level is too low. The engine coolant is not the correct type. The engine coolant leaks. The cooling fan is not running. | "Engine Cooling System" in the2.8.7 Diagnostic Information and Procedures. |
| | 9. Excessive Engine Oil in Combustion Chamber and Valve Seal Leakage | "Engine Mechanical System" in the2.6.7 Diagnostic Information and Procedures. |
| | 10. Cylinder Compression Pressure Too High | |
| | 11. Excessive Carbon Residue in Combustion Chamber | |
| | 12. Camshaft, Cylinder Head, Piston, Connecting Rod and Bearing Abnormal | |

| Symptoms | Suspected Fault Items | Relevant Sections |
|---|---|---|
| Retardation, Engine Speed Decrease, Engine Speed Instable<br>Fault Definition: When pressing the accelerator pedal, there is no immediate response. This fault may occur at any vehicle speed. The vehicles first starts (for example, after stopping off hours), this fault is usually more pronounced. In severe cases, this fault may lead to engine stall. | 1. ECM Power Supply Circuit | This section2.2.7.37 DTC P0560 P0562 P0563. |
| | 2. Intake Manifold Absolute Pressure (MAP) Sensor | This section2.2.7.17 DTC P0105 P0106 P0107 P0108. |
| | 3. Fuel Pressure Abnormal | "Fuel System" in the2.3.7 Diagnostic Information and Procedures. |
| | 4. Injector Working Abnormal | |
| | 5. The Air-Fuel Mixture Too Rich | This section2.2.7.21 DTC P0130 P0131 P0132 P0133 P0134 P2195 P2196. |
| | 6. The Air-Fuel Mixture Too Lean | |
| | 7. Ignition System: Spark Plug Abnormal, Ignition Wire Abnormal | "Ignition System" in the2.10.7 Diagnostic Information and Procedures. |
| | 8. Knock Sensor (KS) System Ignition Delay Too Great | |
| | 9. Crankshaft Position Sensor | This section2.2.7.29 DTC P0321 P0322. |
| | 10. Thermostat Abnormal | "Engine Cooling System" in the2.8.7 Diagnostic Information and Procedures. |
| | 11. Generators Working Abnormal | "Starting/Charging System" in the2.11.7 Diagnostic Information and Procedures. |
| Lack of Fuel Supply, Misfire<br>Fault Definition: After the engine speed increases, there is continuous pulsation, or jitter, usually even more noticeable with the engine load increases. When the engine speed is above 1,500 rpm, the fault does not appear. | 1. ECM Power Supply Circuit | This section2.2.7.37 DTC P0560 P0562 P0563. |
| | 2. Air Cleaner Filter Blocked | --- |
| | 3. Fuel Pressure Abnormal | "Fuel System" in the2.3.7 Diagnostic Information and Procedures. |
| | 4. Injector Working Abnormal | |
| | 5. Idle Air Control Valve | This section2.2.8.1 Idle Air Control Valve Replacement. |
| | 6. The Air-Fuel Mixture Too Rich or Too Lean | This section2.2.7.21 DTC P0130 P0131 P0132 P0133 P0134 P2195 P2196. |
| | 7. Knock Sensor (KS) System Ignition Delay Too Great | "Ignition System" in the2.10.7 Diagnostic Information and Procedures. |
| | 8. Spark Plug: Thermal Value Incorrect, damp, Crack, Gap Incorrect, Excessive Erosion, Excessive Carbon Residue, Contaminated by Fuel | |
| | 9. Spark Plug Wire Damage | |
| | 10. Ignition Coil Damage | |
| | 11. Crankshaft Position Sensor | This section2.2.7.29 DTC P0321 P0322. |
| | 12. Excessive Engine Oil in Combustion Chamber or Valve Seals Leakage | "Engine Mechanical System" in the2.6.7 Diagnostic Information and Procedures. |

| Symptoms | Suspected Fault Items | Relevant Sections |
|---|---|---|
| Lack of Fuel Supply, Misfire Fault Definition: After the engine speed increases, there is continuous pulsation, or jitter, usually even more noticeable with the engine load increases. When the engine speed is above 1,500 rpm, the fault does not appear. | 13. Cylinder Compression Pressure Incorrect | |
| | 14. Valve Stagnant or Leakage | |
| | 15. Camshaft Convex Corner Wear | |
| | 16. Valve Timing Incorrect | |
| | 17. Valve Spring Broken | |
| | 18. Excessive Carbon Residue in Combustion Chamber | |
| | 19. Camshaft, Cylinder Head, Piston, Connecting Rod and Bearing Abnormal | |
| | 20. Exhaust Not Smooth: Three-way Catalytic Converter Plug, Muffler Internal Damage | "Engine Exhaust System" in the2.7.5 Diagnostic Information and Procedures. |
| | 21. Electromagnetic Interference (EMI) in the voltage circuit may lead to engine Misfire. Use the scan tool to monitor the engine speed to detect electromagnetic interference. Engine speed parameters sudden increase while the actual engine speed is almost no change indicates the presence of electromagnetic interference. If there is a fault, check whether there is a high voltage part in the vicinity of the ignition control circuit. | --- |

## 2.2.7.5 ECM Connector Terminal Table




Note:

1. UB represents the battery voltage.
2. If there is no instructions, GND is 0 V or close to 0 V.

| Terminal Number | Name | Wire | Terminal Description | Status | Specified Condition |
|---|---|---|---|---|---|
| 1 | - | - | - | - | - |
| 2 | AT-CVVT1 | 0.85 W/L | Intake Variable Cam Timing (Intake) | Idle | GND (<0.85 V)-UB of The PWM Wave |
| 3 | A-P-ZUE1I | 0.85 W | Ignition Coil 1, Cylinder 4 Control | Idle | GND (<1.8 V)-UB of The PWM Wave clamping voltage (nominal) 400 V |
| 4 | AS-LSHHK | 0.85 G/B | Post-Catalytic Heated Oxygen Sensor Control | When Heated | GND-UB of The PWM Wave |
| 5 | MM-ZUE | 1.5 B | Ground (Ignition Ground) | All Status | 0 Ω |
| 6 | AS-LSHVK | 0.85 B/O | Pre-Catalytic Heated Oxygen Sensor Control | When Heated | GND-UB of The PWM Wave |

| Terminal Number | Name | Wire | Terminal Description | Status | Specified Condition |
|---|---|---|---|---|---|
| 7 | AP-ZUE2I | 0.85 Y | Ignition Coil 2, Cylinder 3 Control | Idle | GND (<1.8 V)-UB of The PWM Wave, Clamping Voltage (Nominal) 400 V |
| 8 | U-U-UBR | 1.5 B/R | Power Supply Controlled by The Main Relay | Ignition Switch "ON" | UB |
| 9 | - | - | - | - | - |
| 10 | E-S-PSW | 0.5 W/V | Air-Conditioning Medium Voltage Switch | On or Off | GND or UB |
| 11 | - | - | - | - | - |
| 12 | E-S-EL1 | 0.5 Br/R | Power Steering Switch | On or Off | GND or UB |
| 13 | - | - | - | - | - |
| 14 | E-S-BR | 0.5 G | Sensor Reference Voltage | Ignition Switch "ON" | 5 V |
| 15 | B-D-DIAK | 0.5 B/W | Diagnostic Wire K/Anti-theft Wire W | Sometimes | PWM Wave |
| 16 | U-U-UBD | 0.5 R | Continuous Power Supply | All Status | UB |
| 17 | E-S-KL15 | 0.5 W/Y | Ignition Switch | Ignition Switch "ON" | UB |
| 18 | A-U-5V2 | 0.5 G | 5V Power Supply 2 | Ignition Switch "ON" | 5 V |
| 19 | A-U-5V1 | 0.5 Br/Y | 5V Power Supply 1 | Ignition Switch "ON" | 5 V |
| 20 | - | - | - | - | - |
| 21 | A-T-SMB | 0.5 O | Idle Air Control Valve Phase B | Sometimes | ND (<0.45 V)-UB of The PWM Wave |
| 22 | A-T-SMA | 0.5 G/Br | Idle Air Control Valve Phase A | Sometimes | GND (<0.45V)-UB of The PWM Wave |
| 23 | AS-SVS | 0.5 P | SVS Anti-theft Wire R | When Lights On | <0.85 V |
| 24 | E-S-EL2 | 0.5 L | Air-Conditioning Control Module | Driver Instruction | GND or UB |
| 25 | E-A-TANS | 0.5 Gy/R | Intake Air Temperature Sensor | Ignition Switch "ON" | 0-5 V |
| 26 | E-A-DKG | 0.5 G/Y | Throttle Body Position Sensor | Idle | |
| 27 | - | - | - | - | - |
| 28 | - | - | - | - | - |
| 29 | E-A-LSHK | 0.5 L/Y | Post-Catalytic Heated Oxygen Sensor Control | Idle | |
| 30 | E-A-KS1A | 0.5 L | Knock Sensor A-Side | Idle | PWM Wave, AB Conjugate Signal |

| Terminal Number | Name | Wire | Terminal Description | Status | Specified Condition |
|---|---|---|---|---|---|
| 31 | E-A-KS1B | 0.5 L/W | Knock Sensor B-Side | Idle | |
| 32 | A-S-HR | 0.5 B/R | Main Relay | Ignition Switch "ON" | <1.8 V |
| 33 | B-D-CANH | 0.5 L/R | CAN Bus Interface | | |
| 34 | B-D-CANL | 0.5 Y/R | CAN Bus Interface | | |
| 35 | A-T-SMC | 0.5 L | Idle Air Control Valve Phase C | Sometimes | GND (<0.45 V)-UB of The PWM Wave |
| 36 | A-T-SMD | 0.5 V/O | Idle Air Control Valve Phase D | Sometimes | GND (<0.45 V)-UB of The PWM Wave |
| 37 | A-T-TEV | 0.5 B/Y | Canister Valve | Sometimes | GND (<0.85 V)-UB of The PWM Wave |
| 38 | - | - | - | - | - |
| 39 | M-R-SEN1 | 0.5 O/G | Sensor Ground 1 | | |
| 40 | M-R-SEN2 | 0.5 Gr | Sensor Ground 2 | | |
| 41 | E-A-TMOT | 0.5 V | Engine Coolant Temperature Sensor Signal | Ignition Switch "ON" | 0-5 V |
| 42 | E-S-ZYHA | 0.5 R/B | Phase Sensor Signal | | GND-UB of The PWM Wave |
| 43 | M-M-EL1 | 0.5 B | Ground (Electronics Ground) | All Status | 0 Ω |
| 44 | E-S-AC | 0.5 V/W | Air-Conditioning Switch | Driver Instruction | GND or UB |
| 45 | E-A-LSVK | 0.5 L/R | Post-Catalytic Heated Oxygen Sensor Control | Ignition Switch "ON" | |
| 46 | E-F-DGB | 0.5 Gy | Engine Speed Sensor B-Side | Magnetic-electric, Engine Running | Sin/Cos Wave, AB Conjugate Signal |
| 47 | E-F-DGA | 0.5 G | Engine Speed Sensor A-Side | | |
| 48 | M-M-ES1 | 0.5 B | Ground (Power Ground) | All Status | 0 Ω |
| 49 | A-T-EV2 | 0.5 Y/V | Injector 3 (Cylinder No.3) Control | When Engine Running | GND (<0.9 V)-UB of The PWM Wave clamping voltage (nominal) 69 V |
| 50 | A-T-EV1 | 0.5 G/L | Injector 1 (Cylinder No.1) Control | When Engine Running | |
| 51 | U-U-UBR | 0.5 B/R | Power Supply Controlled by The Main Relay | Ignition Switch "ON" | UB |

| Terminal Number | Name | Wire | Terminal Description | Status | Specified Condition |
|---|---|---|---|---|---|
| 52 | A-S-FAN2 | 0.5 Lg/R | High-Speed Fan Relay Control | The water temperature reaches the temperature that turns on High-Speed fan. | GND or UB |
| 53 | - | - | - | - | - |
| 54 | - | - | - | - | - |
| 55 | - | - | - | - | - |
| 56 | - | - | - | - | - |
| 57 | E-F-vfZ | 0.5 Y | Vehicle Speed Signal | When the Vehicle is Driven | GND-UB of The PWM Wave |
| 58 | - | - | - | - | - |
| 59 | E-A-DS | 0.5 L/B | Intake Air Pressure Sensor Signal | Ignition Switch "ON" | GND-UB |
| 60 | A-S-KOS | 0.5 Y/R | Air-Conditioning Compressor Relay Control | ECM Command | GND (<2 V) or UB |
| 61 | A-S-EKP | 0.5 G/R | Fuel Pump Relay Control | Ignition Switch "ON" | GND (2 V) or the UB |
| 62 | A-S-FAN1 | 0.5 Lg | Low-Speed Fan Relay Control | The water temperature teaches the temperature that turns on Low-Speed fan. | GND (1.35 V) or the UB |
| 63 | A-T-EV4 | 0.5 Y/B | Injector 2 (Cylinder No.2) Control | Engine Running | GND (<0.9 V)-UB of The PWM Wave clamping voltage (nominal) 69 V |
| 64 | A-T-EV3 | 0.5 B/L | Injector 4 (Cylinder No.4) Control | Engine Running | GND (<0.9 V)-UB of The PWM Wave clamping voltage (nominal) 69 V |

## 2.2.7.6 DTC Code Type Definition

| Fault Type | Definition |
|---|---|
| Type 2 | Fire-related troubleshooting is generally defined as type 2. For cause of damage to catalytic converters Misfire MIL flashing lights to warn the driver immediately. With the emission deterioration fault caused by misfire, if the corresponding level of misfire is fully detected in three consecutive driving cycles, the MIL lamp is lit. The fault will be deleted after 40 continuous trouble-free warmed-up driving cycles. |
| Type 3 | If a fault is detected in consecutive three driving cycles, the MIL lamp is lit. If the fault has been repaired after 3 consecutive driving cycles, the MIL lamp will be off. The fault will be deleted after 40 continuous trouble-free warmed-up driving cycles. |

| | |
|---|---|
| Type 4 | The MIL lamp will be lit in 2.5s when a fault occurs. If the fault has been repaired after 3 consecutive driving cycles, the MIL lamp will be off. The fault will be deleted after 40 continuous trouble-free warmed-up driving cycles. |
| Type 5 | A fault is confirmed after it is detected in 3 consecutive driving cycles, and the fault lamp will not be lit. If the fault is detected as repaired after 3 consecutive driving cycles, the fault has been repaired. The fault will be deleted after 40 continuous trouble-free warmed-up driving cycles. |
| Type 6 | The fault is confirmed as soon as it occurs. The fault will be deleted after 40 continuous trouble-free warmed-up driving cycles. This type of fault does not trigger any lamp and is not readable by a universal scan tool. |
| Type 7 | External testing tools activate the external fuel supply system fault diagnosis path. It is generally used in offline inspection or in a repair station. This type of fault does not trigger any lamp and is not readable by a universal scan tool. |
| Type 11 | It is dedicated to fuel supply system diagnostic path. If a fault has been detected in 3 continuous driving cycles, the MIL lamp will be lit. If the fault is detected as repaired after 4 consecutive driving cycles, the MIL lamp will be off. The fault will be deleted after 40 continuous trouble-free warmed-up driving cycles. |
| Type 35 | To identify and repair the fault is through timing. To remove the fault from the memory needs 20 driving cycle. It is generally readable for a universal scan tool abd triggers flashing MIL lamp. |
| Type 38 | To identify and repair the fault is through timing. Removal of the fault from memory is triggered by time. It is generally readable for a universal scan tool |

## 2.2.7.7 DTC Code (DTC) list

| DTC Code | Description | Type | Fault Lamp |
|---|---|---|---|
| P000A | Intake VVT Slow Response | 5 | OFF |
| P0010 | VVT Intake Control Solenoid Valve Open Circuit | 3 | ON |
| P0012 | The intake VVT is not at the default location when starting. | 5 | OFF |
| P0016 | Improper Relative Installation Positions Between Camshaft and Crankshaft | 3 | ON |
| P0030 | Pre-Catalytic Heated Oxygen Sensor Control Circuit Open | 3 | ON |
| P0031 | Pre-Catalytic Heated Oxygen Sensor Control Circuit Short to Ground | 3 | ON |
| P0032 | Pre-Catalytic Heated Oxygen Sensor Control Circuit Short to Power Supply | 3 | ON |
| P0036 | Post-Catalytic Heated Oxygen Sensor Control Circuit Open | 3 | ON |
| P0037 | Post-Catalytic Heated Oxygen Sensor Control Circuit Short to Ground | 3 | ON |
| P0038 | Post-Catalytic Heated Oxygen Sensor Control Circuit Short to Power Supply | 3 | ON |
| P0053 | Pre-Catalytic Heated Oxygen Sensor Internal Resistance Unreasonable | 3 | ON |

| DTC Code | Description | Type | Fault Lamp |
|---|---|---|---|
| P0054 | Post-Catalytic Heated Oxygen Sensor Internal Resistance Unreasonable | 3 | ON |
| P0105 | Intake Air Pressure Sensor Signal No Change (Frozen) | 3 | ON |
| P0106 | Intake Air Pressure Sensor Malfunction | 3 | ON |
| P0107 | Intake Air Pressure Sensor Circuit Short to Ground | 3 | ON |
| P0108 | Intake Air Pressure Sensor Circuit Short to Power Supply | 3 | ON |
| P0112 | Intake Air Pressure Sensor Circuit Voltage Too Low | 3 | ON |
| P0113 | Intake Air Pressure Sensor Circuit Voltage Too High | 3 | ON |
| P0117 | Engine Coolant Temperature Sensor Circuit Voltage Too Low | 3 | ON |
| P0118 | Engine Coolant Temperature Sensor Circuit Voltage Too High | 3 | ON |
| P122 | Throttle Position Sensor Circuit Voltage Lower Than Minimum Limit | 3 | ON |
| P123 | Throttle Position Sensor Circuit Voltage Higher Than Maximum Limit | 3 | ON |
| P130 | Pre-Catalytic Heated Oxygen Sensor Signal Unreasonable | 3 | ON |
| P131 | Pre-Catalytic Heated Oxygen Sensor Signal Circuit Voltage Too Low | 3 | ON |
| P132 | Pre-Catalytic Heated Oxygen Sensor Signal Circuit Voltage Too High | 3 | ON |
| P0133 | Pre-Catalytic Heated Oxygen Sensor Aging | 3 | ON |
| P0134 | Pre-Catalytic Heated Oxygen Sensor Signal Malfunction | 3 | ON |
| P0136 | Post-Catalytic Heated Oxygen Sensor Signal Unreasonable | 3 | ON |
| P0137 | Post-Catalytic Heated Oxygen Sensor Signal Circuit Voltage Too Low | 3 | ON |
| P0138 | Post-Catalytic Heated Oxygen Sensor Signal Circuit Voltage Too High | 3 | ON |
| P0140 | Post-Catalytic Heated Oxygen Sensor Signal Circuit Malfunction | 3 | ON |
| P0170 | Air-Fuel Ratio After Catalyst Unreasonable Comparing to Closed-loop Control Self Learn | 7 | OFF |
| P0171 | Air-Fuel Ratio After Catalyst Too Lean Comparing to Closed-loop Control Self Learn | 7 | OFF |
| P0172 | Air-Fuel Ratio After Catalyst Too Rich Comparing to Closed-loop Control Self Learn | 7 | OFF |
| P0201 | Cylinder No.1 Fuel Injector Control Circuit Open | 3 | ON |
| P0202 | Cylinder No.2 Fuel Injector Control Circuit Open | 3 | ON |

| DTC Code | Description | Type | Fault Lamp |
|---|---|---|---|
| P0203 | Cylinder No.3 Fuel Injector Control Circuit Open | 3 | ON |
| P0204 | Cylinder No.4 Fuel Injector Control Circuit Open | 3 | ON |
| P0261 | Cylinder No.1 Fuel Injector Control Circuit Short to Ground | 3 | ON |
| P0262 | Cylinder No.1 Fuel Injector Control Circuit Short to Power Supply | 3 | ON |
| P0264 | Cylinder No.2 Fuel Injector Control Circuit Short to Ground | 3 | ON |
| P0265 | Cylinder No.2 Fuel Injector Control Circuit Short to Power Supply | 3 | ON |
| P0267 | Cylinder No.3 Fuel Injector Control Circuit Short to Ground | 3 | ON |
| P0268 | Cylinder No.3 Fuel Injector Control Circuit Short to Power Supply | 3 | ON |
| P0270 | Cylinder No.4 Fuel Injector Control Circuit Short to Ground | 3 | ON |
| P0271 | Cylinder No.4 Fuel Injector Control Circuit Short to Power Supply | 3 | ON |
| P0300 | Multiple Cylinder Misfire | 2 | ON |
| P0301 | Cylinder No.1 Misfire | 2 | ON |
| P0302 | Cylinder No.2 Misfire | 2 | ON |
| P0303 | Cylinder No.3 Misfire | 2 | ON |
| P0304 | Cylinder No.4 Misfire | 2 | ON |
| P0321 | Speed Reference Point Malfunction | 3 | ON |
| P0322 | No Crankshaft Position Sensor Pulse Signal (Open or Short Circuit) | 3 | ON |
| P0327 | Knock Sensor Signal Circuit Voltage Too Low | 3 | ON |
| P0328 | Knock Sensor Signal Circuit Voltage Too High | 3 | ON |
| P0340 | Camshaft Position Sensor Unreasonably Installed | 3 | ON |
| P0341 | Camshaft Position Sensor Poor Connection | 3 | ON |
| P0342 | Camshaft Position Sensor Circuit Short to Ground | 3 | ON |
| P0343 | Camshaft Position Sensor Circuit Short to Ground Power Supply | 3 | ON |
| P0420 | Catalytic Converter Oxygen Storage Capacity Aging (Emission Over the Limit) | 3 | ON |
| P0444 | Canister Control Valve Control Circuit Open | 3 | ON |
| P0458 | Canister Control Valve Control Circuit Voltage Too Low | 3 | ON |
| P0459 | Canister Control Valve Control Circuit Voltage Too High | 3 | ON |
| P0480 | Cooling Fan Relay Control Circuit Open (Low Speed) | 5 | OFF |
| P0481 | Cooling Fan Relay Control Circuit Malfunction (High Speed) | 5 | OFF |
| P0501 | Vehicle Speed Sensor Signal Unreasonable | 3 | ON |
| P0506 | Idle Control Speed Lower Than Target | 3 | ON |

| DTC Code | Description | Type | Fault Lamp |
|---|---|---|---|
| P0507 | Idle Control Speed Higher Than Target | 3 | ON |
| P0508 | Stepper Motor Driver Pin Short to Ground | 3 | ON |
| P0509 | Stepper Motor Driver Pin Short to Power Supply | 3 | ON |
| P0511 | Stepper Motor Driver Pin Open Circuit | 3 | ON |
| P0560 | System Battery Voltage Signal Unreasonable | 5 | OFF |
| P0562 | Battery Voltage Too Low | 5 | OFF |
| P0563 | Battery Voltage Too High | 5 | OFF |
| P0602 | Electronic Control Unit Code Malfunction | 3 | ON |
| P0627 | Fuel Pump Relay Control Circuit Open | 3 | ON |
| P0628 | Fuel Pump Relay Control Circuit Short to Ground | 3 | ON |
| P0629 | Fuel Pump Relay Control Circuit Short to Power Supply | 3 | ON |
| P0645 | A/C Compressor Relay Control Circuit Open | 5 | OFF |
| P0646 | A/C Compressor Relay Control Circuit Short to Ground | 5 | OFF |
| P0647 | A/C Compressor Relay Control Circuit Short to Power Supply | 5 | OFF |
| P0650 | MIL Lamp Driver Circuit Malfunction | 3 | ON |
| P0691 | Cooling Fan Relay Control Circuit Short to Ground (Low Speed) | 5 | OFF |
| P0692 | Cooling Fan Relay Control Circuit Short to Power Supply (Low Speed) | 5 | OFF |
| P0694 | Cooling Fan Relay Control Circuit Short to Power Supply (High speed) | 5 | OFF |
| P1523 | Airbag to ECU Signal Interrupted or Incorrect | 5 | OFF |
| P1610 | Anti-theft Malfunction | 38 | Blink |
| P1611 | Anti-theft Malfunction | 38 | Blink |
| P1612 | Anti-theft Malfunction | 35 | Blink |
| P1613 | Anti-theft Malfunction | 35 | Blink |
| P1614 | Anti-theft Malfunction | 35 | Blink |
| P2088 | VVT Intake Control Solenoid Valve Circuit Short to Ground | 3 | ON |
| P2089 | VVT Intake Control Solenoid Valve Circuit Short to Power Supply | 3 | ON |
| P2177 | Air-Fuel Ratio Closed-loop Self Learn Higher Than Maximum Limit | 11 | ON |
| P2178 | Air-Fuel Ratio Closed-loop Self Learn Lower Than Minimum Limit | 11 | ON |
| P2187 | Air-Fuel Ratio Closed-loop Self Learn Higher Than Maximum Limit (Low Load Zone) | 11 | ON |
| P2188 | Air-Fuel Ratio Closed-loop Self Learn Lower Than Minimum Limit (Low Load Zone) | 11 | ON |

| DTC Code | Description | Type | Fault Lamp |
|---|---|---|---|
| P2195 | Pre-Catalytic Oxygen Sensor Aging (Too Lean) | 3 | ON |
| P2196 | Pre-Catalytic Oxygen Sensor Aging (Too Rich) | 3 | ON |
| P2270 | Post-Catalytic Oxygen Sensor Aging (Too Lean) | 3 | ON |
| P2271 | Post-Catalytic Oxygen Sensor Aging (Too Rich) | 3 | ON |
| U0001 | CAN High-Speed Data Communication Cable Malfunction | 6 | OFF |
| U0121 | Communication with ABS Controller Interrupted | 6 | OFF |
| U0140 | Communication with BCM Interrupted | 6 | OFF |
| U0151 | Communication with airbag control module Interrupted | 6 | OFF |

## 2.2.7.8 DTC Fail-Safe Table

| DTC code | Component | Fail-Safe Operation | Fail-Safe Lifting Condition |
|---|---|---|---|
| P0105, P0106, P0107 and P0108 | Intake Manifold Pressure Sensor | ECM Alternative Pressure 1,013 kPa | Eligible Requirements Detected |
| P0112 and P0113 | Intake Manifold Temperature Sensor | ECM Alternative Temperature 20.3°C (68.54 °F) | Eligible Requirements Detected |
| P0117 and P0118 | Engine Coolant Temperature Sensor | ECM Alternative Water Temperature and Load-related Calculations, Up to 90°C (194 °F) | Eligible Requirements Detected |
| P0560, P0562 and P0563 | Battery Voltage | Unreasonable fault occurs, ECM alternative voltage 14V | Eligible Requirements Detected |
| P0501 | Vehicle Speed Sensor | No diagnose for idle, battery voltage, speed reference point | Eligible Requirements Detected |
| P0321 | Speed Sensor Reference Point Signal | When a fault occurs, stop the misfire diagnostics. | Eligible Requirements Detected |
| P0322 | Speed Sensor | NLDG Working | Eligible Requirements Detected |
| P0122 and P0123 | Throttle Position Sensor | Stop fuel self learn and the catalytic converter diagnosis. | Eligible Requirements Detected |
| P0340, P0341, P0342 and P0343 | Phase Sensor | Stop fuel self learn, oxygen sensor diagnosis and speed aging diagnosis. | Eligible Requirements Detected |
| P0506 and P0507 | Idle Stepper Motor | Stop stepper motor self learn. | Eligible Requirements Detected |
| P1523 | Airbag Controller Signal to ECU | Airbag Signal to Stop Fuel Supply Disabled | Eligible Requirements Detected |

| DTC code | Component | Fail-Safe Operation | Fail-Safe Lifting Condition |
|---|---|---|---|
| P0262, P0261, P0201, P0268, P0267, P0203, P0271, P0270, P0204, P0265, P0264, P0202 | Injectors 1,2,3,4 | Prolonged Fault, Misfire | Eligible Requirements Detected |
| P0030, P0031 and P0032 | Pre-Catalytic Oxygen Sensor Circuit | Oxygen Sensor Internal Resistance Diagnosis Stop | Eligible Requirements Detected |
| P0036, P0037 and P0038 | Post-Catalytic Oxygen Sensor Circuit | Oxygen Sensor Internal Resistance Diagnosis Stop | Eligible Requirements Detected |
| P0480, P0481, P0691, P0692 and P0694 | High and Low-Speed Cooling Fan Relay | N/A | N/A |
| P0645, P0646 and P0647 | Air-Conditioning Relay | N/A | N/A |
| P0627, P0628 and P0629 | Fuel Pump Relay | Engine Can Not Start | |
| P0650 | MIL Lamp Circuit | N/A | N/A |
| P0508, P0509, P0511 | Stepper Motor Driver Stage Circuit | N/A | N/A |
| P0444, P0458 and P0459 | Canister Driver Stage Circuit | Close Post-Catalytic Oxygen Sensor Control | Eligible Requirements Detected |
| U0140 | BCM and ECM Communication | N/A | N/A |
| U0121 | ABS and ECM Communication | N/A | N/A |
| U0151 | Airbag Controller and ECM Communication | N/A | N/A |
| U0001 | CAN | N/A | N/A |
| P0606 | Electronic Control Unit Code Fault | N/A | N/A |
| P1610, P1611, P1612, P1613, P1614 | Anti-theft Controller | Engine Can Not Start | Turn On Power, Anti-theft Authentication Successful |
| P0300, P0301, P0302, P10303, P0304 | Spark Plug, Fuel Injector, Ignition Coil, etc. | One or More Cylinder Misfire | Restart |
| P0328, P0327 | Knock Sensor | Ignition Angle Delay | Fault Repair, Knock Sensor Working Properly |
| P000A | VVT | Calculate the basic ignition angle when the camshaft adjustment is no longer considered. | Eligible Requirements Detected |
| P0012 | VVT | Calculate the basic ignition angle when the camshaft adjustment is no longer considered. | Eligible Requirements Detected |

| DTC code | Component | Fail-Safe Operation | Fail-Safe Lifting Condition |
|---|---|---|---|
| P0016 | Crankshaft and Camshaft Relative Installation Position | Misfire cylinder can not be determined. Cylinder group fuel injection. | Eligible Requirements Detected |
| P0010, P2088, P2089 | VVT Circuit | Stop VVT diagnosis. | Eligible Requirements Detected |
| P0420 | Catalytic Converter Oxygen Storage Capacity Aging (Emission Over Limit) | Stop catalytic converter related self learn. | Replace new three-way catalytic converter. |
| P0053 | Pre-Catalytic Heated Oxygen Sensor Internal Resistance Unreasonable | Stop some diagnosis. | Check circuit fault or replace Pre-Catalytic heated oxygen sensor. |
| P0054 | Post-Catalytic Heated Oxygen Sensor Internal Resistance Unreasonable | Stop some diagnosis. | Check circuit fault or replace Post-Catalytic heated oxygen sensor |
| P0130, P0131, P0132, P0134 | Pre-Catalytic Heated Oxygen Sensor Signal Unreasonable | Entering Into Open-loop Control | Check circuit fault or replace Pre-Catalytic heated oxygen sensor. |
| P0133, P2195, P2196 | Pre-Catalytic Heated Oxygen Sensor Aging | No | Replace Pre-Catalytic heated oxygen sensor. |
| P0136, P0137, P0138, P0140 | Check Post-Catalytic heated oxygen sensor signal circuit. | Disconnect the Post-Catalytic heated oxygen sensor. | Check circuit fault or replace the Post-Catalytic heated oxygen sensor. |
| P2270, P2271 | Post-Catalytic Heated Oxygen Sensor Aging | Disconnect the Post-Catalytic heated oxygen sensor. | Replace the Post-Catalytic heated oxygen sensor. |
| P2177 | Air-Fuel ratio close-loop control self learn value is higher than maximum limit. | No Protection Needed | Check fuel line fault. |
| P2178 | Air-Fuel ratio close-loop control self learn value is lower than minimum limit. | No Protection Needed | Check fuel line fault. |
| P2187 | Air-Fuel ratio close-loop control self learn value is higher than maximum limit (Low-Load Zone). | No Protection Needed | Check fuel line fault. |
| P2188 | Air-Fuel ratio close-loop control self learn value is lower than minimum limit (Low-Load Zone). | No Protection Needed | Check fuel line fault. |

## 2.2.7.9 Data Stream List

By reading the "Data Stream List" on the scan tool, you can check switches, sensors, actuators working state without removing any parts. Before the control system diagnosis, observing and analyzing data is the first step, so that the diagnose time could be shortened.

Note

Data under normal conditions is listed in the following table for reference only. Do not determine whether a part is faulty solely based on these reference values. Under normal circumstances you can compare the vehicle that needs to be repaired with a normal working vehicle in the same state to determine the current vehicle diagnostic data is normal or not.

1. Run the engine to reach normal working temperature.
2. Turn the ignition switch to "OFF" position.
3. Connect the scan tool.
4. Turn the ignition switch to "ON" position.
5. Select "Engine"/"Read data stream".
6. Refer to the table and check all the data.

| Data Stream Name | Ignition Switch "ON" | Idle Speed | 2,500 rpm When | Diagnosis Description |
|---|---|---|---|---|
| Battery Voltage | 12.04 V | 13.51 V | 13.72 V | ECM monitors the current charging system working conditions. |
| Engine Speed | 0 rpm | 800 rpm | 2,500 rpm | The scan tool shows the current actual engine speed calculated by ECM through the crankshaft position sensor input. |
| Target Idle Speed (No Compensation) | 800 rpm | 800 rpm | 1,500 rpm | The scan tool shows the target idle speed set by ECM and the current actual idle speed, said ECM instructions. ECM-based engine coolant temperature sensors signal and compensation signals for various engine loads in order to maintain desired engine idle speed. |
| Target Idle Speed (With Compensation) | 800 rpm | 800 rpm | 800 rpm | |
| Vehicle Speed | 0 km | 0 km | 0 km | - |
| Engine Coolant Temperature Sensor Voltage | 0.5 V | 0.5 V | 0.4 V | The scan tool shows -40°C (-40 ºF) to 130°C (266 ºF). After heating, sensor (internal resistance decreases) voltage signal reduces. ECM will interpret the reduced voltage signal as engine warmed up. This signal is one of the conditions used to determine whether to activate the closed-loop fuel system control, and also an important injection timing reference signal. |
| Engine Coolant Temperature | 91°C (196 ºF) | 89°C (192 ºF) | 94°C (201 ºF) | |
| Intake Air Temperature Sensor | 2.5 V | 2.5 V | 3.0 V | Sensor voltage is the value actually received by ECM. The intake air temperature is calculated by ECM using the received voltage signal according to the program. ECM apply the intake air temperature to adjust the fuel delivery and |

| Data Stream Name | Ignition Switch "ON" | Idle Speed | 2,500 rpm When | Diagnosis Description |
|---|---|---|---|---|
| Intake Air Temperature | 23°C (73.4 ºF) | 23°C (73.4 ºF) | 14°C (57.2 ºF) | ignition timing according to the air density. The intake air temperature is also compared with the ECT to identify the start up of the heating wire of the heated oxygen sensor and diagnosis of evaporative emissions from cold start. |
| Ambient Temperature | 10°C (50 ºF) | 10°C (50 ºF) | 10°C (50 ºF) | Varies as the ambient temperature changes. |
| The Actual Intake Manifold Pressure Sensor Voltage | 4.02 V | 1.0 V | 0.71 V | 1. Equal to atmospheric pressure when engine is turned off.<br>2. Voltage first reduced and then increased when pressing the acceleration pedal hard.<br>3. After engine is turned off, the data stream shows the pressure is close to atmospheric pressure, voltage close to 5 V. |
| The Actual Intake Manifold Pressure | 1,020 kPa (148 psi) | 340 kPa (49 psi) | 260 kPa (38 psi) | |
| Intake Air Mass | 0.0 g/s | 10.2 g/s | 29.4 g/s | |
| Stepper Motor Target Location | 69 step | 40 step | 93 step | After engine is turned off, it shows 110 steps. Warmed vehicle idling state, it is typically about 30 to 45 steps. The number of steps increases as the load increases like Air-Conditioning turned on, up to 70 steps. With the increase in vehicle mileage, the stepper motor opening will increase. After cleaning the stepper motor and the intake air channel next to the throttle body, the steps will not decrease during the startup. But the engine speed will increase. |
| Throttle Angle ADC Signal | 0.55 V | 0.56 V | 0.70 V | Throttle position sensor voltage is the voltage Measure by ECM. While the angle is calculated according to voltage. When at idle, the voltage is 0.3-0.9V. With full-throttle the voltage is 4.25-4.7V. The voltage increases as the throttle opening increases. The self learn value will become larger and larger when the throttle body is dirty and move up the zero value. After cleaning the throttle, the computer will automatically re-learn. |
| Calculating Throttle Position and Angle Signal | 11.1% | 11.23% | 14.06% | |
| Calculating Throttle Position | 0% | 0% | 2% | |
| Charging Time | 3.6 ms | 3.0 ms | 3.0 ms | - |

| Data Stream Name | Ignition Switch "ON" | Idle Speed | 2,500 rpm When | Diagnosis Description |
|---|---|---|---|---|
| Average Injector Pulse Width | 0.0 ms | 3.2 ms | 2.4 ms | Scan tool shows 0-16ms. It indicates that in each engine cycle, the number of the engine control module command connected to each injector. The greater the fuel injector pulse width, the more the fuel is injected. Injector pulse width (PWM) increases as the engine load increases. If the engine receives increasing torque signal, it will increase the injection time. Many factors affect the fuel injection time, such as engine coolant temperature sensor, intake air temperature sensor, power supply voltage and fuel pressure. |
| Cylinder No.1 Spark Advance Angle | 0° | 6° | 33.5° | At normal idle speed, the current ignition system advance angle is 7° ahead of TDC. This value is for repair reference only. |
| Knock Sensor Signal 1 | 0 V | 0 V | 0 V | ECM detects knock sensors amplitude and frequency to control the ignition timing. Ignition timing is placed in the position close to knocking to get the maximum torque. |
| Knock Sensor Signal 2 | 0 V | 0 V | 0 V | |
| Cylinder No.1 Ignition Delay | 0.0° | 0.0° | 0.0° | ECM calculates according to knock sensor signals. If the knocking is detected, ECM controls the ignition advance angle delay. |
| Cylinder No.2 Ignition Delay | 0.0° | 0.0° | 0.0° | |
| Cylinder No.3 Ignition Delay | 0.0° | 0.0° | 0.0° | |
| Cylinder No.4 Ignition Delay | 0.0° | 0.0° | 0.0° | |
| Group 1 Oxygen Sensor Integral Value (Short-Term Correction) | 1.00 | 0.99 | 1.02 | Based on feedback from oxygen sensor, increase or decrease the basic injection duration with a temporary value. It is useful only in the closed-loop control. When it is a positive value, ECM will increase the amount of fuel injected by increasing the injection duration. When it is a negative value, ECM will decrease the injection duration. When the short-term value is continuously lower or higher than the theoretical value, ECM will add this value to the long-term fuel value or deduct it from the long-term fuel value, in order to achieve optimum Air-Fuel ratio control. |

| Data Stream Name | Ignition Switch "ON" | Idle Speed | 2,500 rpm When | Diagnosis Description |
|---|---|---|---|---|
| Group 1 Oxygen Sensor Voltage 1 (Pre-Catalytic Oxygen Sensor) | 0.4 V | 0.1-0.7 V | 0.1-0.7 V | Under normal operating conditions, $HO_2S$ output is 0.1-0.9V voltage. ECM receives this voltage signal and measures whether the Air-Fuel ratio is lean or rich. If ECM input signal voltage is lower than 0.45V, the Air-Fuel ratio is lean; if the input signal voltage is above 0.45V, the Air-Fuel ratio is rich. In the closed-loop control, ECM continuously detects $HO_2S$ output signal to reduce or increase the fuel injection control pulse width to adjust. |
| Group 1 Oxygen Sensor Voltage 2 (Post-Catalytic Oxygen Sensor) | 0.6 V | 0.7 V | 0.7 V | The Post-Catalytic oxygen sensor is installed after the catalytic converter or in exhaust pipe. The Post-Catalytic oxygen sensor output voltage is between 0 V-1V. Use the Post-Catalytic oxygen sensor signal to detect the catalytic converter efficiency. If the conversion efficiency of catalytic converters is good, the Post-Catalytic oxygen sensor signal is stable. If the catalytic converter is aging, toxic or Misfire and so on, the conversion efficiency of catalytic converters will decrease. The Post-Catalytic oxygen sensor signal will be similar to the Pre-Catalytic oxygen sensor signal. |
| Group 1 Oxygen Sensor Integral Value (Long-Term Adjustments) | 1.0 | 1.0 | 1.0 | The long-term fuel adjustment value is stored in ECM memory, because it is calculated as part of the basic injection duration. It will not be deleted when ignition switch is OFF. It affects the closed-loop control and open-loop control injection duration. ECM uses the short-term adjustment value to modify the long-term fuel adjustment value. It can not respond quickly to the instant changes. It only changes when ECM decides to use the short-term fuel adjustment value to adjust the long-term fuel adjustment value. Like the short-term fuel value adjustment, when the long-term value is 0%, it indicates that the basic injection duration does not need adjustment. Positive percentage indicates the fuel injection increase; while a negative percentage indicates the fuel injection decrease. The long-term value is for engine to control the entire range of injection duration. It is divided into two categories; long-term idle and long-term under load. When is engine speed is lower than 920 rpm and the air volume is 24kg/h, it monitors long-term idle. Because the relatively small amount of intake air, |

| Data Stream Name | Ignition Switch "ON" | Idle Speed | 2,500 rpm When | Diagnosis Description |
|---|---|---|---|---|
| Ultimate Long-term Adjustment Factor | 2.2% | 2.2% | 2.2% | adding more fuel or decrease fuel amount is need to control idle speed. Different from long-term idle, when the engine load is 30-75% and the air volume is 40-200kg/h, it monitors the long-term engine load and uses multiple-tuning to control idle speed. |
| Intake Camshaft PWM Control | 5.86% | 5.86% | 5.8% | VVT intake camshaft position actuator current actual opening changes from 0% to 100%. The largest advance position is 100% and the maximum lag position is 0%. |
| Intake Valve Opening (As Opposed to LWOT) | 8° | 8° | 8° | |
| Camshaft Overlap Angle | 494° | 494° | 494° | |
| Idle Torque, Self Learn | 1.8% | 1.8% | 1.3% | - |
| Idle Speed Control Target Torque Adjustment | 0.0% | -0.3% | 0% | - |
| Engine Relative Load | 100% | 18.2% | 14.7% | - |
| Run-Time After a Speed Fault | 0 min | 0 min | 0 min | - |
| Canister Control to Fuel Injection Amount | 0% | 0% | 1.2% | Using Canister solenoid valve opening duty cycle control, the control signal is the pulse waveform and can be detected with an oscilloscope. This |

| Data Stream Name | Ignition Switch "ON" | Idle Speed | 2,500 rpm When | Diagnosis Description |
|---|---|---|---|---|
| Canister Control Valve Duty Cycle | 0% | 0% | 100% | parameter shows the evaporative emission control module commands (EVAP) solenoid valve Canister clean-up power supply time or duty cycle. 0% indicates that no clean-up carried out and 100% indicates always clean-up. |
| Canister Purification Rate | 0% | 0% | 0.1% | Fuel evaporative emission control system prevents hydrocarbons (HC) overflow from the fuel tank into the atmosphere, polluting the environment. Collect the fuel vapor into the Canister. ECM controls solenoid valve (EVAP) to remove Canister collected fuel vapor steam and make it into the engine for combustion. In the actual repair work, compare the data stream to the actual solenoid valve opening. If a leak occurs, it is necessary to know how to determine. Note that only when the engine reaches the normal temperature, the data stream will increase from a small value. When idling or engine cold, the EVAP will not open. |
| Canister Load | 1 | 3.2 | 0.7 | |

## 2.2.7.10 Action Test Table

By reading the "Action Test Table" on the scan tool, you can check switches, sensors, actuators working state without removing any parts. Before the control system diagnosis, carrying out action test is a prerequisite, so that the diagnose time could be shortened.

Note

Data under normal conditions is listed in the following table for reference only. Do not determine whether a part is faulty solely based on these reference values. Under normal circumstances you can compare the vehicle that needs to be repaired with a normal working vehicle in the same state to determine the current vehicle diagnostic data is normal or not.

1. Run the engine to reach normal working temperature.
2. Turn the ignition switch to "OFF" position.
3. Connect scan tool.
4. Turn the ignition switch to "ON" position.
5. Select "engine"/"action test".
6. Refer to the following table to test.

| Scan Tool Display Item | Test Component | Control Range | Diagnosis Description |
|---|---|---|---|
| Fault Indicator | Enable the engine fault indicator. | ON/OFF | When the engine is running (or) the ignition switch is turned on, with the signal accepted, the engine control module will request the fault indicator to light through the CAN bus. The fault indicator will be on or off in 3-5s. |

| Scan Tool Display Item | Test Component | Control Range | Diagnosis Description |
|---|---|---|---|
| Fuel Pump Relay | Enable the fuel pump relay. | ON/OFF | Note<br>This test can only be carried out when the vehicle speed is equal to zero and vehicle speed sensor has no fault.<br>This function can control the fuel pump relay. Fuel pump relay will be on or off within 3-5s. |
| Canister Control Valve | Enable the Canister solenoid valve. | ON/OFF | When the command is "ON" the solenoid valve will be on or off within 3-5s. |
| Fan 1 | Enable the Low-Speed cooling fan. | ON/OFF | Note<br>Carry out this test only when the engine coolant temperature is below 100°C (212 ºF)and Air-Conditioning is not switched on.<br>This function controls the Low-Speed cooling fan relay. When the instruction is received, the cooling fan will be on at high speed for 5s. |
| Fan 2 | Enable High-Speed cooling fan | ON/OFF | Note<br>Carry out this test only when the engine coolant temperature is below 100°C (212 ºF)and Air-Conditioning is not switched on.<br>This function controls the High-Speed cooling fan relay. When the instruction is received, the cooling fan will be on at high speed for 5s. |
| Air-Conditioning Clutch | Enable the Air-Conditioning compressor clutch. | ON/OFF | Note<br>Carry out this test only when the ignition switch is at "ON" position and the engine is not running.<br>This function controls Air-Conditioning compressor relay. When the instruction is "ON", the Air-Conditioning compressor relay will be on or off in 3-5s. |
| Fuel Injection Disable | Disable the fuel injection. | ON/OFF | Note<br>This function will not close the two fuel injectors at the same time. perform the test only when the vehicle speed is zero, the speed sensor without fault and oxygen sensor signal indicating a lean Air-Fuel ratio.<br>Disable fuel injectors and test fuel injectors sealing state. |

| Scan Tool Display Item | Test Component | Control Range | Diagnosis Description |
|---|---|---|---|
| Ignition Delay | Delay the ignition advance angle. | --- | --- |
| Idle Speed Control | Control engine speed to the required speed. | • 600 rpm<br>• 700 rpm<br>• 800 rpm<br>• 900 rpm<br>• 1,000 rpm<br>• 2,000 rpm | Control engine speed to the required speed. |
| Stepper Motor Actuator Test | Test idle control valve to open a few steps. | --- | Note<br>Carry out this test only when the engine is not running and the ignition switch is at "ON" position. |

## 2.2.7.11 DTC Code Index

| DTC Code | Description | Diagnostic Procedures |
|---|---|---|
| P000A | Intake VVT Slow Response | Refer to 2.2.7.13 DTC P000A P0012. |
| P0010 | VVT Intake Control Solenoid Valve Circuit Open | Refer to 2.2.7.12 DTC P0010 P2088 P2089. |
| P0012 | VVT Not At the Default Location During Intake Process | Refer to 2.2.7.13 DTC P000A P0012. |
| P0016 | Unreasonable Camshaft and Crankshaft Relative Installation Position | Refer to 2.2.7.14 DTC P0016. |
| P0030 | Pre-Catalytic Heated Oxygen Sensor Heating Control Circuit Open | Refer to 2.2.7.15 DTC P0030 P0031 P0032 P0053. |
| P0031 | Pre-Catalytic Heated Oxygen Sensor Heating Control Circuit Short to Ground | |
| P0032 | Pre-Catalytic Heated Oxygen Sensor Heating Control Circuit Short to Power Supply | |
| P0036 | Post-Catalytic Heated Oxygen Sensor Heating Control Circuit Open | Refer to 2.2.7.16 DTC P0036 P0037 P0038 P0054. |
| P0037 | Post-Catalytic Heated Oxygen Sensor Heating Control Circuit Short to Ground | |
| P0038 | Post-Catalytic Heated Oxygen Sensor Heating Control Circuit Short to Power Supply | |

| DTC Code | Description | Diagnostic Procedures |
|---|---|---|
| P0053 | Pre-Catalytic Heated Oxygen Sensor Internal Heating Resistance Unreasonable | Refer to 2.2.7.15 DTC P0030 P0031 P0032 P0053. |
| P0054 | Post-Catalytic Heated Oxygen Sensor Internal Heating Resistance Unreasonable | Refer to 2.2.7.16 DTC P0036 P0037 P0038 P0054. |
| P0105 | Intake Air Pressure Sensor Signal No Change (Frozen) | Refer to 2.2.7.17 DTC P0105 P0106 P0107 P0108. |
| P0106 | Intake Air Pressure Sensor Unreasonable | |
| P0107 | Intake Air Pressure Sensor Circuit Short to Ground | |
| P0108 | Intake Air Pressure Sensor Circuit Short to Power Supply | |
| P0112 | Intake Air Temperature Sensor Circuit Voltage Too Low | Refer to 2.2.7.18 DTC P0112 P0113. |
| P0113 | Intake Air Temperature Sensor Circuit Voltage Too High | |
| P0117 | Engine Coolant Temperature Sensor Circuit Voltage Too Low | Refer to 2.2.7.19 DTC P0117 P0118. |
| P0118 | Engine Coolant Temperature Sensor Circuit Voltage Too High | |
| P0122 | Throttle Position Sensor Circuit Voltage Lower Than Minimum | Refer to 2.2.7.20 DTC P0122 P0123. |
| P0123 | Throttle Position Sensor Circuit Voltage Higher Than Maximum | |
| P0130 | Pre-Catalytic Heated Oxygen Sensor Signal Unreasonable | Refer to 2.2.7.21 DTC P0130 P0131 P0132 P0133 P0134 P2195 P2196. |
| P0131 | Pre-Catalytic Heated Oxygen Sensor Circuit Voltage Too Low | |
| P0132 | Pre-Catalytic Heated Oxygen Sensor Circuit Voltage Too High | |
| P0133 | Pre-Catalytic Heated Oxygen Sensor Aging | |
| P0134 | Pre-Catalytic Heated Oxygen Sensor Circuit Malfunction | |
| P0136 | Oxygen Sensor Signal Unreasonable | Refer to 2.2.7.22 DTC P0136 P0137 P0138 P0140 P2270 P2271. |
| P0137 | Post-Catalytic Heated Oxygen Sensor Circuit Voltage Too Low | |
| P0138 | Post-Catalytic Heated Oxygen Sensor Circuit Voltage Too High | |

| DTC Code | Description | Diagnostic Procedures |
|---|---|---|
| P0140 | Post-Catalytic Heated Oxygen Sensor Signal Malfunction | |
| P0170 | Post-Catalytic Air-Fuel Ratio Closed-loop Control self learn Unreasonable | Refer to 2.2.7.23 DTC P0170 P0171 P0172 P2177 P2178 P2187 P2188. |
| P0171 | Post-Catalytic Air-Fuel Ratio Closed-loop Control self learn Too Lean | |
| P0172 | Post-Catalytic Air-Fuel Ratio Closed-loop Control self learn Too Rich | |
| P0201 | Cylinder No.1 Fuel Injection Control Circuit Open | Refer to 2.2.7.24 DTC P0201 P0261 P0262. |
| P0202 | Cylinder No.2 Fuel Injection Control Circuit Open | Refer to 2.2.7.25 DTC P0202 P0264 P0265. |
| P0203 | Cylinder No.3 Fuel Injection Control Circuit Open | Refer to 2.2.7.26 DTC P0203 P0267 P0268. |
| P0204 | Cylinder No.4 Fuel Injection Control Circuit Open | Refer to 2.2.7.27 DTC P0204 P0270 P0271. |
| P0261 | Cylinder No.1 Fuel Injection Control Circuit Short to Ground | Refer to 2.2.7.24 DTC P0201 P0261 P0262. |
| P0262 | Cylinder No.1 Fuel Injection Control Circuit Short to Power Supply | |
| P0264 | Cylinder No.2 Fuel Injection Control Circuit Short to Ground | Refer to 2.2.7.25 DTC P0202 P0264 P0265. |
| P0265 | Cylinder No.2 Fuel Injection Control Circuit Short to Power Supply | |
| P0267 | Cylinder No.3 Fuel Injection Control Circuit Short to Ground | Refer to 2.2.7.26 DTC P0203 P0267 P0268. |
| P0268 | Cylinder No.3 Fuel Injection Control Circuit Short to Power Supply | |
| P0270 | Cylinder No.4 Fuel Injection Control Circuit Short to Ground | Refer to 2.2.7.27 DTC P0204 P0270 P0271. |
| P0271 | Cylinder No.4 Fuel Injection Control Circuit Short to Power Supply | |
| P0300 | Multi-Cylinder Misfire | Refer to 2.2.7.28 DTC P0300-P0304. |
| P0301 | Cylinder No.1 Misfire | |
| P0302 | Cylinder No.2 Misfire | |
| P0303 | Cylinder No.3 Misfire | |
| P0304 | Cylinder No.4 Misfire | |

| DTC Code | Description | Diagnostic Procedures |
|---|---|---|
| P0321 | Speed Reference Point Fault | Refer to 2.2.7.29 DTC P0321 P0322. |
| P0322 | No CKP sensor Pulse Signal (Open or Short Circuit) | |
| P0327 | Knock Sensor Signal Circuit Voltage Too Low | Refer to 2.2.7.30 DTC P0327 P0328. |
| P0328 | Knock Sensor Signal Circuit Voltage Too High | |
| P0340 | Improper Camshaft Position Sensor Installation Location | Refer to 2.2.7.31 DTC P0340-P0343. |
| P0341 | Camshaft Position Sensor Poor Connection | |
| P0342 | Camshaft Position Sensor Circuit Short to Ground | |
| P0343 | Camshaft Position Sensor Circuit Short to Power Supply | |
| P0420 | Three-way Catalytic Converter Oxygen Storage Capacity Aging (Emission Over Limit) | Refer to 2.2.7.32 DTC P0420. |
| P0444 | Canister Control Valve Control Circuit Open | Refer to 2.2.7.33 DTC P0444 P0458 P0459. |
| P0458 | Canister Control Valve Control Circuit Voltage Too Low | |
| P0459 | Canister Control Valve Control Circuit Voltage Too High | |
| P0480 | Cooling Fan Relay Control Circuit Open (Low Speed) | Refer to 2.2.7.34 DTC P0480 P0481 P0691 P0692 P0693 P0694. |
| P0481 | Cooling Fan Relay Control Circuit Malfunction (High Speed) | |
| P0501 | Vehicle Speed Sensor Signal Unreasonable | Refer to 2.2.7.35 DTC P0501. |
| P0506 | Idle Control Speed Lower Than Target Idle Speed | Refer to 2.2.7.36 DTC P0506-P0509 P05111. |
| P0507 | Idle Control Speed Higher Than Target Idle Speed | |
| P0508 | Stepper Motor Driver Pin Circuit Short to Ground | |
| P0509 | Stepper Motor Driver Pin Circuit Short to Power Supply | |
| P0511 | Stepper Motor Driver Pin Circuit Open | |
| P0560 | System Battery Voltage Signal Unreasonable | Refer to 2.2.7.37 DTC P0560 P0562 P0563. |

| DTC Code | Description | Diagnostic Procedures |
|---|---|---|
| P0562 | System Battery Voltage Too Low | |
| P0563 | System Battery Voltage Too High | |
| P0602 | Electronic Control Unit Code Fault | Refer to 2.2.7.38 DTC P0602. |
| P0627 | Pump Relay Control Circuit Open | Refer to 2.2.7.39 DTC P0627 P0628 P0629. |
| P0628 | Pump Relay Control Circuit Short to Ground | |
| P0629 | Pump Relay Control Circuit Short to Power Supply | |
| P0645 | A/C Compressor Relay Control Circuit Open | Refer to 2.2.7.40 DTC P0645-P0647. |
| P0646 | A/C Compressor Relay Control Circuit Short to Ground | |
| P0647 | A/C Compressor Relay Control Circuit Short to Power Supply | |
| P0650 | MIL Lamp Driver Circuit Malfunction | Refer to 2.2.7.41 DTC P0650. |
| P0691 | Cooling Fan Relay Control Circuit Short to Ground (Low Speed) | Refer to 2.2.7.34 DTC P0480 P0481 P0691 P0692 P0693 P0694. |
| P0692 | Cooling Fan Relay Control Circuit Short to Power Supply (Low Speed) | |
| P0693 | Cooling Fan Control Circuit Short to Ground (High Speed) | |
| P0694 | Cooling Fan Control Circuit Short to Power Supply (High Speed) | |
| P1523 | Airbag to ECU Signal Interrupted or Incorrect | Refer to 2.2.7.43 DTC P1523 U0001 U0121 U0140 U0151. |
| P1610 | Anti-theft Malfunction | Refer to 2.2.7.42 DTC P1610-P1614. |
| P1611 | Anti-theft Malfunction | |
| P1612 | Anti-theft Malfunction | |
| P1613 | Anti-theft Malfunction | |
| P1614 | Anti-theft Malfunction | |
| P2088 | VVT Intake Control Solenoid Valve Circuit Short to Ground | Refer to 2.2.7.12 DTC P0010 P2088 P2089. |
| P2089 | VVT Intake Control Solenoid Valve Circuit Short to Power Supply | Refer to 2.2.7.12 DTC P0010 P2088 P2089. |
| P2177 | Air-Fuel Ratio Closed-loop Control self learn Higher Than Maximum Limit | Refer to 2.2.7.23 DTC P0170 P0171 P0172 P2177 P2178 P2187 P2188. |
| P2178 | Air-Fuel Ratio Closed-loop Control self learn Lower Than Minimum Limit | |

| DTC Code | Description | Diagnostic Procedures |
|---|---|---|
| P2187 | Air-Fuel Ratio Closed-loop Control self learn Higher Than Maximum Limit (Low-Load Zone) | Refer to 2.2.7.23 DTC P0170 P0171 P0172 P2177 P2178 P2187 P2188. |
| P2188 | Air-Fuel Ratio Closed-loop Control self learn Lower Than Minimum Limit (Low-Load Zone) | |
| P2195 | Pre-Catalytic Oxygen Sensor Aging (Too Lean) | Refer to 2.2.7.21 DTC P0130 P0131 P0132 P0133 P0134 P2195 P2196. |
| P2196 | Pre-Catalytic Oxygen Sensor Aging (Too Rich) | |
| P2270 | Post-Catalytic Oxygen Sensor Aging (Too Lean) | Refer to 2.2.7.22 DTC P0136 P0137 P0138 P0140 P2270 P2271. |
| P2271 | Post-Catalytic Oxygen Sensor Aging (Too Rich) | |
| U0001 | CAN High-Speed Communication Bus Malfunction | Refer to 2.2.7.43 DTC P1523 U0001 U0121 U0140 U0151. |
| U0121 | Communication With ABS Controller Interrupted | |
| U0140 | Communication With BCM Interrupted | |
| U0151 | Communication With airbag control module Interrupted | |

## 2.2.7.12 DTC P0010 P2088 P2089

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0010 | VVT Intake Control Solenoid Valve Circuit Open |

| | | |
|---|---|---|
| DTC | P2088 | VVT Intake Control Solenoid Valve Circuit Short to Ground |

| | | |
|---|---|---|
| DTC | P2088 | VVT Intake Control Solenoid Valve Circuit Short to Power Supply |

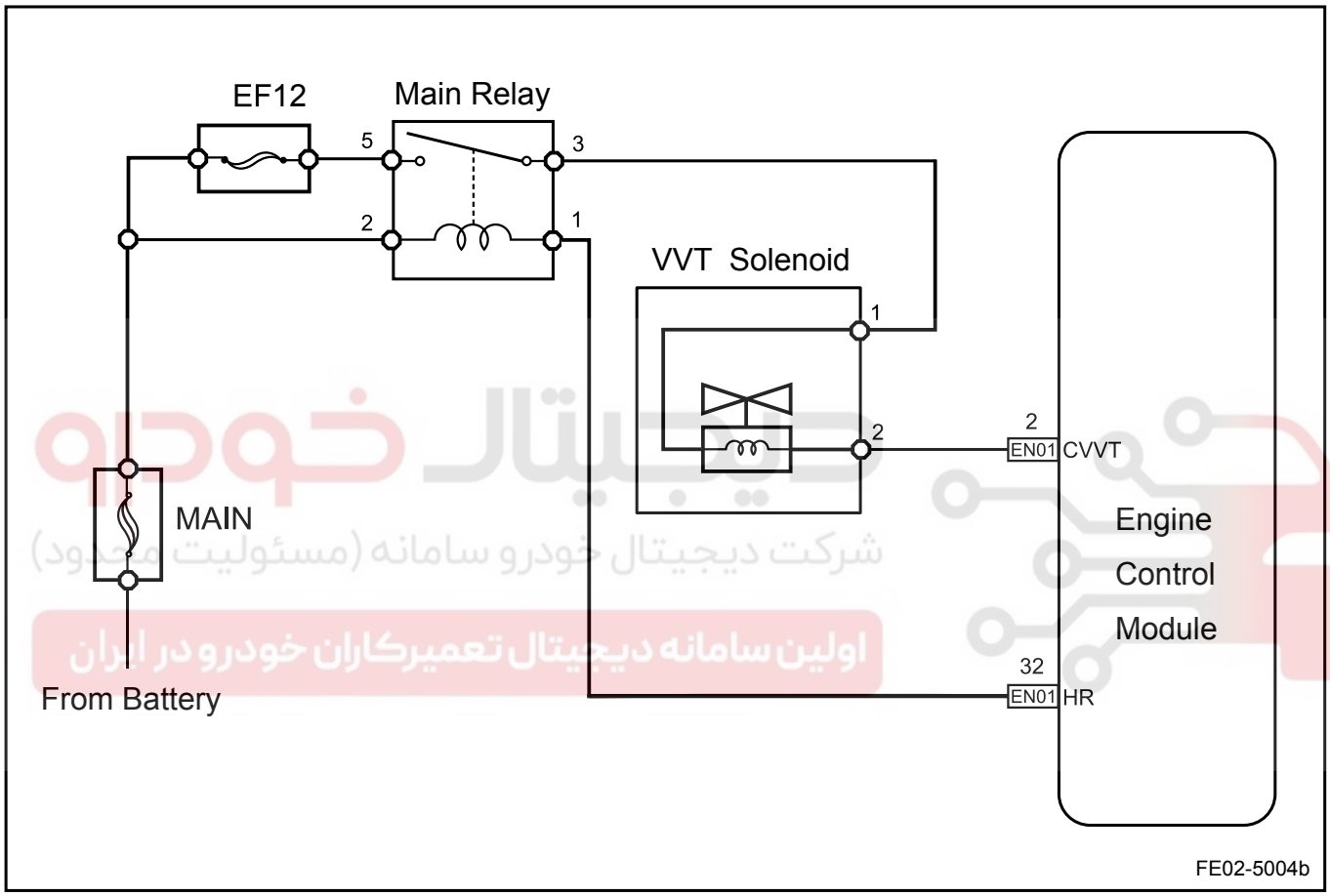
The intake camshaft position actuator is connected to the intake camshaft and operated by hydraulic pressure. The hydraulic pressure is provided by the engine oil pump in order to change the intake camshaft to the crankshaft relative position (CKP ) angle. The intake VVT solenoid valve power supply is provided by The Main Relay. ECM modulates the pulse-width to control signal ground, thus controlling the camshaft position actuator engine oil flow. Engine oil pressure moves the camshaft position actuator slide valve at the front of the camshaft. When the safety slide valve is operated, the engine oil is imported into the camshaft position actuator, so that camshaft rotates. The intake camshaft cam actuator can change the camshaft working angle up to 50°.

ECM controls the solenoid valve internal ground by ECM harness connector EN01 terminal No.2. There is a feedback circuit within ECM. ECM monitors the feedback signals to determine whether there is an open control circuit, or a short to ground circuit or a short to power supply circuit. If ECM detects the control circuit voltage is within a predetermined range, when being disconnected, this DTC code is set.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0010<br>P2088<br>P2089 | Hardware Circuit Checks | 1. Circuit Open.<br>2. Circuit Short to Ground.<br>3. Circuit Short to Power Supply. | 1. Solenoid Valve Circuit<br>2. Solenoid Valve<br>3. ECM |

3. Schematic:

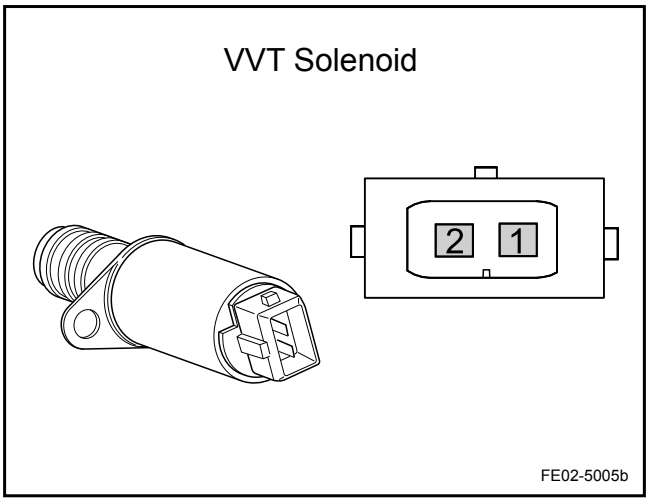



4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Measure VVT solenoid valve assembly resistance. |




(a) Disconnect VVT solenoid valve wiring harness connector EN10.

(b) Measure VVT solenoid valve resistance between the two terminals.

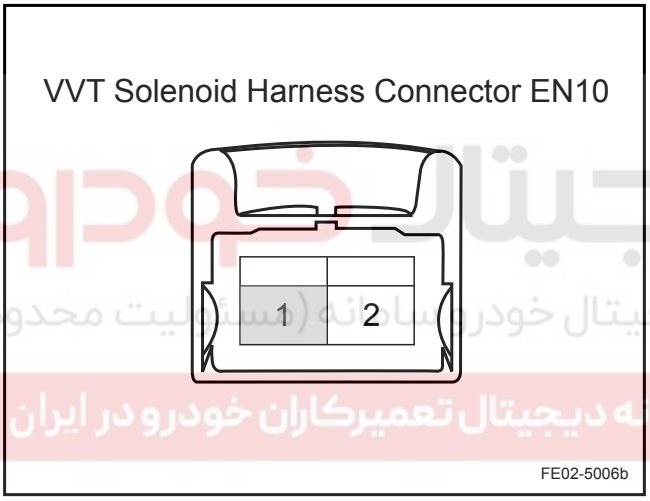
Standard Resistance: 9.4-10.6 Ω (68 ºF) when 20°C

(c) Connect VVT solenoid valve wiring harness connector.

No → Replace VVT solenoid valve assembly. Go to step 6

Yes

| | |
|---|---|
| Step 2 | Measure VVT solenoid valve working power supply voltage. |




(a) Turn the ignition switch to "OFF" position.

(b) Disconnect VVT solenoid valve wiring harness connector EN10.

(c) Turn the ignition switch to "ON" position.

(d) Use multimeter to measure EN10 harness connector terminal No.1.

Standard Voltage: 11-14 V

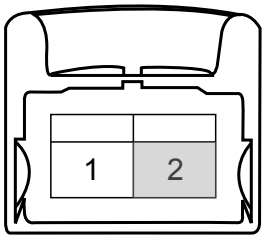
(e) Reconnect VVT solenoid valve wiring harness connector EN10.

No → Check open circuit between EN10 solenoid valve wiring harness connector terminal No.1 and the main relay terminal No.3 or short to ground.

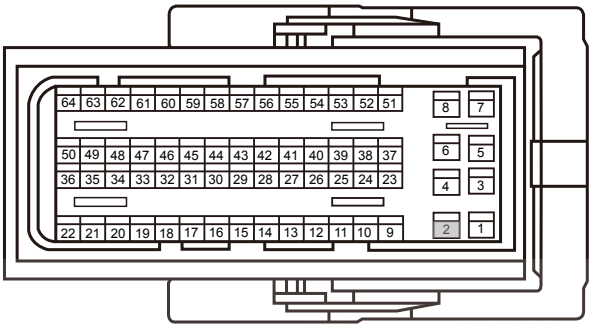
Yes

| | |
|---|---|
| Step 3 | Check VVT solenoid valve control circuit. |

VVT Solenoid Harness Connector EN10




ECM Harness Connector EN01




FE02-5007b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect VVT solenoid valve wiring harness connector EN10.
(c) Disconnect ECM harness connector EN01.
(d) Use multimeter to measure the resistance between VVT solenoid valve wiring harness connector EN10 terminal No. 2 and ECM harness connector EN01 terminal No.2. For the Standard Value. Refer to the table below.
(e) Use multimeter to measure the resistance between VVT solenoid valve wiring harness connector EN10 terminal No. 2 and the ground. For the Standard Value. Refer to the table below.
(f) Turn the ignition switch to "ON" position, (Note: At this time EN01 and EN10 connectors must be disconnected.) Use multimeter to measure the voltage between the VVT solenoid valve wiring harness connector EN10 No.2 terminal and the ground. For the Standard Value. Refer to the table below.

| Test Connection | Standard Value |
|---|---|
| Resistance Between EN10 (2) and EN01 (2) | Less than 1 Ω |
| Resistance Between EN10 (2) and Ground | 10 kΩ or higher |
| Voltage Between EN10 (2) and Ground | 0 V |

All normal?

No → Repair or replace wiring harness connectors.

Yes

| | |
|---|---|
| Step 4 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 5 | Replace ECM. |

Next

| | |
|---|---|
| Step 6 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up engine for at least 5 min.

(e) Road test the vehicle for at least 10 min.

(f) Read DTC control system code again to confirm that there is no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 7 | Diagnostic completed. |

5. Repair Instructions:

Replace VVT solenoid valve. Refer to 2.2.8.4 VVT Solenoid Valve Replacement and Filter Cleaning.

## 2.2.7.13 DTC P000A P0012

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P000A | Intake VVT Slow Response |

| | | |
|---|---|---|
| DTC | P0012 | VVT is not at the default location during air intake process. |

The intake camshaft position actuator is connected to the intake camshaft and operated by hydraulic pressure. The hydraulic pressure is provided by the engine oil pump in order to change the intake camshaft to the crankshaft relative position (CKP ) angle. The intake VVT solenoid valve power supply is provided by The Main Relay. ECM modulates the pulse-width to control signal ground, thus controlling the camshaft position actuator engine oil flow. Engine oil pressure moves the camshaft position actuator slide valve at the front of the camshaft. When the safety slide valve is operated, the engine oil is imported into the camshaft position actuator, so that camshaft rotates. The intake camshaft cam actuator can change the camshaft working angle up to 50°.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P000A | VVT actual angle and target angle difference is too great. | 1. VVT actual angle and target angle difference is too great.<br>2. Camshaft completed self learn.<br>3. Engine oil temperature is between -40°C (-40 ºF) and 120°C (248 ºF).<br>4. Engine coolant temperature is between 0°C (32 ºF) and 105°C (221 ºF ).<br>5. Engine speed is between 600 rpm to 6,000 rpm.<br>6. No VVT circuit fault. | 1. Valve Timing Chain<br>2. VVT Solenoid Valve<br>3. Solenoid Valve Filter<br>4. VVT Actuator Assembly<br>5. ECM |

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0012 | VVT actual angle is not at the default location. | 1. VVT actual angle and target angle difference is greater than or equal to 20°.<br>2. Camshaft completed self learn.<br>3. The engine running time is less than or equal to 1.5 s.<br>4. The engine oil temperature is between -40°C (-40 ºF) and 120°C (248 ºF) .<br>5. The engine coolant temperature is between 0°C (32 ºF) and 105°C (221 ºF ).<br>6. Engine speed is between 600 rpm to 6,000 rpm.<br>7. No VVT circuit fault. | |

3. Schematic:

Refer to 2.2.7.12 DTC P0010 P2088 P2089.

4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Check control system whether there are DTC codes other than DTC P0010, P2088, P2089, P000A, P0012. |

(a) Connect scan tool to datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Press the scan tool power button.
(d) Select the following menu items: Engine/Read DTC codes.
(e) Read DTC codes.

| DTC Codes Shown | To Step |
|---|---|
| DTC P0010, P2088, P2089 | Yes |
| DTC Other Than DTC P0010, P2088, P2089 | No |

No → Refer to 2.2.7.11 DTC Code Index

Yes

| | |
|---|---|
| Step 2 | Check the following items. |

(a) Engine oil viscosity and clean circuits are normal.

(b) Check engine oil level. The engine oil level should be within the range.

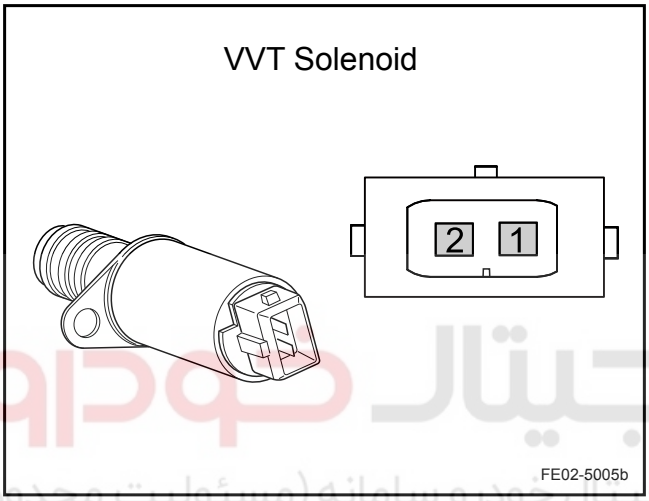
(c) Check if engine oil needs to be replaced or contains additives or engine oil viscosity is not correct.

All normal?

No → Replace the engine oil and oil filter, when necessary, clean the engine lubrication system.

Yes

| Step 3 | Check VVT solenoid valve resistance. |
|---|---|




(a) Disconnect VVT solenoid valve wiring harness connector EN10.

(b) Measure VVT solenoid valve resistance between the two terminals.

Standard Resistance: 9.4-10.6 Ω (68 ºF) when 20°C

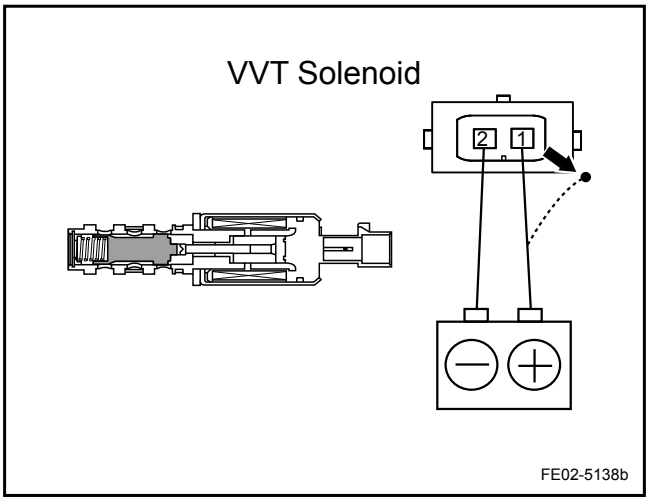
No → Replace VVT solenoid valve. Refer to 2.2.8.4 VVT Solenoid Valve Replacement and Filter Cleaning. Go to step 8

Yes

Note

Connecting two wires directly is strictly prohibited in the testing process, as it might cause an explosion, fire and other dangers.

| Step 4 | Check VVT solenoid valve operation. |
|---|---|




(a) Connect the battery positive terminal with the VVT solenoid valve terminal No.1 and the negative terminal with the VVT solenoid valve terminal No.2.

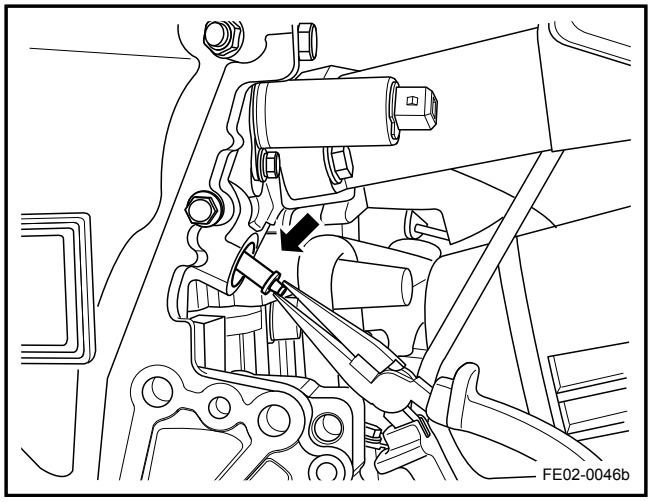
(b) Check the spool operation.

Spool activated?

No → Replacement VVT solenoid valve. Refer to 2.2.8.4 VVT Solenoid Valve Replacement and Filter Cleaning

Yes

| Step 5 | Check VVT solenoid valve filter. |
|---|---|



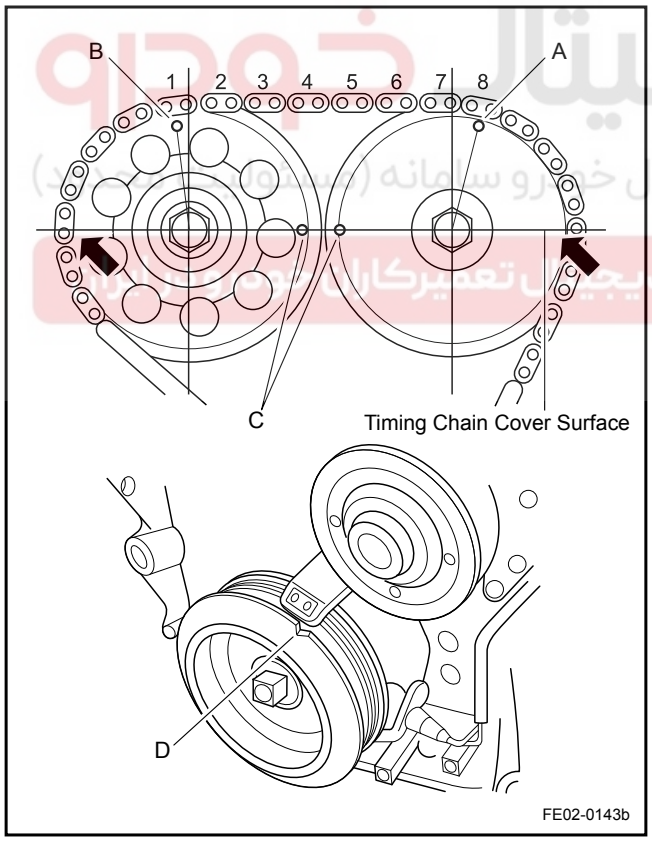

(a) Remove VVT solenoid valve filter.
(b) Check whether filter is blocked.
(c) Check whether filter is damaged.
(d) Re-install VVT solenoid valve filter.

Does VVT solenoid valve filter work properly?

No → Clean VVT solenoid valve filter, if necessary, replace the VVT solenoid valve filter.

Yes

| Step 6 | Check whether timing system is normal. |
|---|---|




(a) Remove the cylinder head cover.
(b) Align point D, rotate crankshaft pulley, so that timing mark on the pulley aligned with the marked "0" on the timing chain cover.
(c) Check point C, make sure the camshaft timing gear timing mark as shown in the graphic aligned with horizontal position.
(d) Check points A, B point, make sure the distance between intake and exhaust camshaft gear timing marks A and B is 8 timing chain section.
(e) Re-install the cylinder head cover.

Are timing marks shown as in above graphics?

No → Adjust the valve timing.

Yes

| Step 7 | Replace VVT actuator assembly. |
|---|---|

Next

| | |
|---|---|
| Step 8 | Check control system DTC code. |

(a) Connect scan tool to datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Press scan tool power button.
(d) Select the following menu items: Engine/Read DTC codes.
(e) Read DTC codes.

Are there DTC codes?

No → Intermittent Fault. Refer to 2.2.7.4 Fault Symptom Table

Yes

| | |
|---|---|
| Step 9 | Diagnostic completed. |

5. Repair Instructions:

The intake VVT actuator assembly is only replaced as as assembly. Do not repair its disassembled components. For VVT actuator replacement, refer to 2.6.8.12 Camshaft Replacement.

## 2.2.7.14 DTC P0016

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0016 | Unreasonable Camshaft and Crankshaft Relative Installation Position |

Engine Control Module (ECM) uses crankshaft position sensor (CKP) and camshaft position sensor (CMP) pulse signals to monitor the correlation between crankshaft position and camshaft position. Crankshaft variable reluctance rotor has 60 teeth, of which two missing teeth were used as a reference gap. Each tooth spaces 6° evenly, except the reference gap with a 12° interval. Camshaft signal plate has 4 teeth, 2 narrow teeth and 2 wide ones. Each tooth trailing edge evenly spaces at 90°.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0016 | The difference between crankshaft and camshaft synchronization learn value and reference value | 1. When camshaft and crankshaft angle difference is greater than 20°, the DTC code is set. When the angle is greater than 25°, the camshaft and the crankshaft adaptive is activated.<br>2. The camshaft and crankshaft angle difference is greater than the negative 25°. | 1. Timing Chain Tensioner<br>2. Timing Chain<br>3. Crank Sprocket<br>4. Exhaust Sprocket<br>5. VVT Actuator<br>6. ECM |

3. Schematic:

Refer to 2.2.7.29 DTC P0321 P0322.

4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Check valve timing system. |

(a) Check whether camshaft, crankshaft and timing chain is correct.

(b) Check whether timing chain tensioning force is normal.

No → Go to step 4

Yes

| | |
|---|---|
| Step 2 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.

(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 3 | Replace ECM. |

Next → Go to step 5

Note

Use of Lubrication system cleaner is not recommended. Such cleaning agents contain strong solvent and may have side effects on seals and other engine components.

| | |
|---|---|
| Step 4 | Adjust and repair the mechanical timing system. |

(a) Read the vehicle service records and identify whether recent services included the timing chain, camshaft or crankshaft, and whether engine oil change intervals are too long.

(b) If the engine oil is contaminated or contains impurities, the reasons should be identified. Remove timing chain, camshaft position actuators and the sprocket. Refer to 2.6.8.10 Timing Chain Replacement. Remove VVT solenoid valve that filters the engine oil provided to the intake camshaft actuator. Refer to 2.2.8.4 VVT Solenoid Valve Replacement and Filter Cleaning. Check filters and oil channel whether there are impurities. Clean filters and replace the filter if necessary.

(c) If the engine oil pressure is too low, identify causes and carry out necessary repairs.

Next

| | |
|---|---|
| Step 5 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.

(b) Turn the ignition switch to "ON" position.

(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 5 min.
(f) Read control system DTC code again to confirm that the system has no DTC code.

Next

| | |
|---|---|
| Step 6 | Diagnostic completed. |

## 2.2.7.15 DTC P0030 P0031 P0032 P0053

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0030 | Pre-Catalytic oxygen sensor heating control circuit open |

| | | |
|---|---|---|
| DTC | P0031 | Pre-Catalytic oxygen sensor heating control circuit short to ground |

| | | |
|---|---|---|
| DTC | P0032 | Pre-Catalytic oxygen sensor heating control circuit short to power supply |

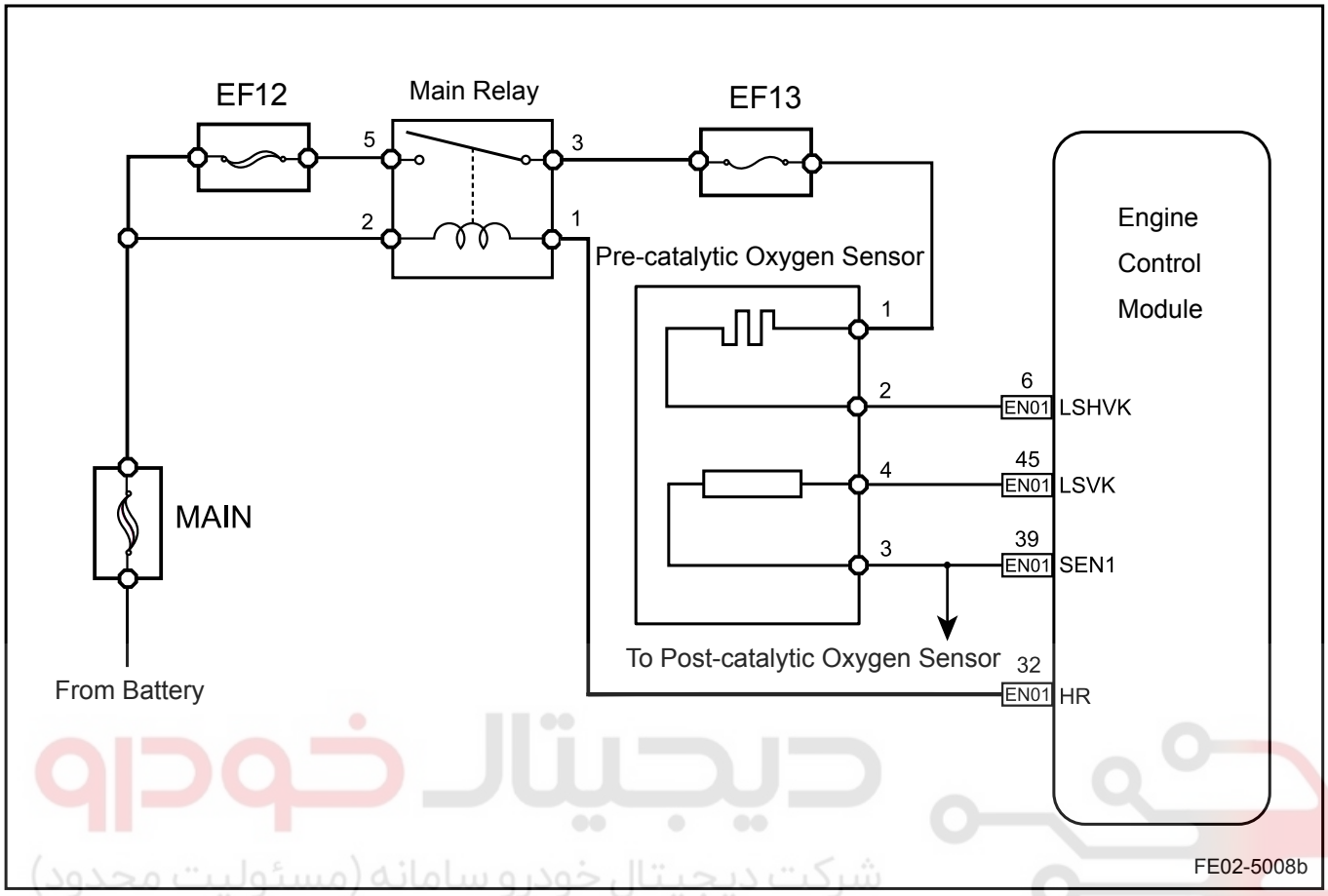
The Pre-Catalytic heated oxygen sensor ($HO_2S$) is used for fuel control. The sensor compares the oxygen content in ambient air with the oxygen content in exhaust flow. Each heated oxygen sensor has an internal heating element for sensor heating. ECM controls the heated oxygen sensor heating control circuit. This makes the system enter into the closed-loop control mode earlier, so that ECM can calculate Air-Fuel ratio earlier. ECM commands heater control module switched on or off, so that heated oxygen sensor works within the specified working temperature range. Engine control module detects the temperature by Measure the heater current.

The Pre-Catalytic heated oxygen sensor heating coil voltage is provided by The Main Relay, which is controlled by ECM. When the ignition switch is turned to "ON" position, harness connector EN02 terminal No.1 voltage is provided by the battery. ECM controls heater working time through ECM harness connector EN01 terminal No.6.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0030<br>P0031<br>P0032 | Hardware Circuit Checks | 1. Circuit Open.<br>2. Circuit Short to Ground.<br>3. Circuit Short to Power Supply. | 1. Sensor Circuit<br>2. Sensor<br>3. ECM |
| P0053 | Resistance is greater than the set value. | 1. The current Pre-Catalytic oxygen sensor internal resistance is greater than 1500 Ω.<br>2. The current exhaust gas temperature is between 200°C (392 ºF) and 550°C (1,022 ºF). | |

3. Schematic:




4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Initial inspection. |

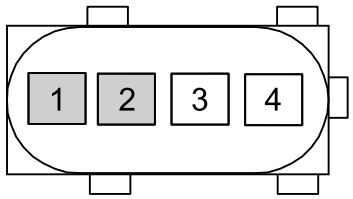
Check the existence of following factors that will affect the heated oxygen sensor working status:

(a) Exhaust system leaks or blockage.
(b) Water entering into the heated oxygen sensor connector.
(c) After engine working in high temperatures, whether exhaust pipes are too hot.

Next

| | |
|---|---|
| Step 2 | Check the Pre-Catalytic oxygen sensor heater resistance. |

Pre-catalytic Oxygen Sensor




FE02-5009b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect oxygen sensor wiring harness connector.
(c) Measure heater resistance between the Pre-Catalytic oxygen sensor terminal No.1 and terminal No.2.

Standard Resistance: 9 Ω(68 ºF) at 20°C

(d) Connect the Pre-Catalytic oxygen sensor wiring harness connector.

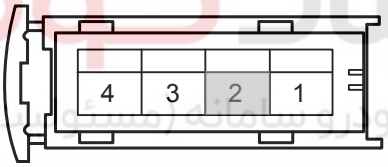
Is resistance the specified value?

No → Replace the Pre-Catalytic oxygen sensor. Refer to 2.4.7.2 Pre-Catalytic Oxygen Sensor Replacement

Yes

| | |
|---|---|
| Step 3 | Check the terminal No.2 to ground voltage. |

Pre-catalytic Oxygen Sensor Harness Connector EN02




FE02-5010b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the Pre-Catalytic oxygen sensor wiring harness connector.
(c) Turn the ignition switch to "ON" position.
(d) Measure the Pre-Catalytic oxygen sensor wiring harness connector EN02 terminal No.1 to ground voltage.

Standard Voltage Value: Voltage between the EN02 terminal No.1 and the ground is 11-14 V.

(e) Connect the Pre-Catalytic oxygen sensor wiring harness connector.

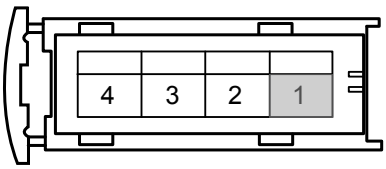
Is voltage the specified values?

No → Pre-Catalytic Oxygen Sensor Power Supply Circuit Fault

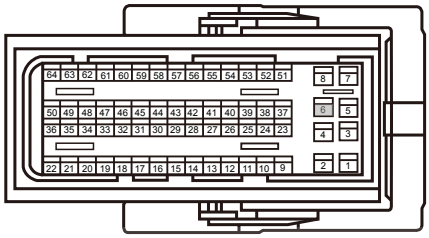
Yes

| | |
|---|---|
| Step 4 | Check the Pre-Catalytic oxygen sensor terminal heating control signal continuity. |

Pre-catalytic Oxygen Sensor Harness Connector EN02




ECM Harness Connector EN01



FE02-5011b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the Pre-Catalytic oxygen sensor wiring harness connector EN02.
(c) Disconnect ECM harness connector EN01.
(d) Test continuity between the Pre-Catalytic oxygen sensor wiring harness connector EN02 terminal No.2 and ECM harness connector EN01 terminal No.6.

Standard Resistance: Less than 1 Ω

(e) Connect ECM harness connector EN01.
(f) Connect the Pre-Catalytic oxygen sensor wiring harness connector EN02.

Is resistance the specified value?

| | |
|---|---|
| No | ECM control circuit malfunction |

Yes

| | |
|---|---|
| Step 5 | Check ECM working circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuits is normal.

| | |
|---|---|
| No | Repair the faulty part. |

Yes

| | |
|---|---|
| Step 6 | Replace ECM. Refer to 2.2.8.8 Engine Control Module Replacement. |

Next

| | |
|---|---|
| Step 7 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 5 min.
(f) Read control system DTC code again to confirm that the system has no DTC code.

| | |
|---|---|
| No | Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check |

Yes

| | |
|---|---|
| Step 8 | Diagnostic completed. |

5. Repair Instructions:

Replace the Pre-Catalytic oxygen sensor. Refer to 2.4.7.2 Pre-Catalytic Oxygen Sensor Replacement.

## 2.2.7.16 DTC P0036 P0037 P0038 P0054

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0036 | Post-Catalytic Oxygen Sensor Heating Control Circuit Open |
| DTC | P0037 | Post-Catalytic Oxygen Sensor Heating Control Circuit Short to Ground |
| DTC | P0038 | Post-Catalytic Oxygen Sensor Heating Control Circuit Short to Power Supply |
| DTC | P0054 | Post-Catalytic Oxygen Sensor Heating Resistance Unreasonable |

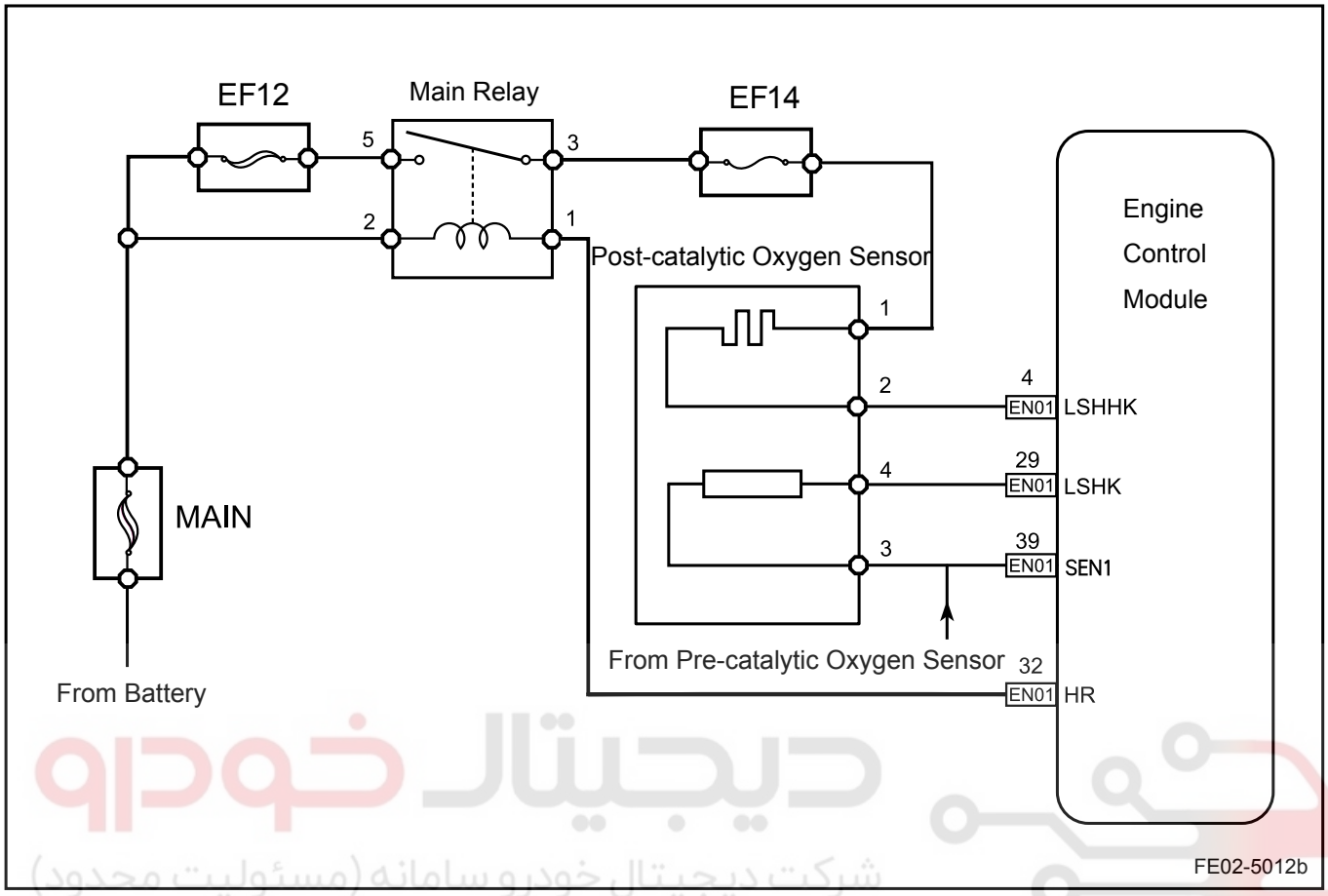
The Post-Catalytic heated oxygen sensor ($HO_2S$) is used for monitoring three-way catalytic converter working status. The sensor compares the oxygen content in ambient air with the oxygen content in exhaust flow. Each heated oxygen sensor has an internal heating element for sensor heating. ECM controls the heated oxygen sensor heating control circuit. This makes the system enter into the closed-loop control mode earlier, so that ECM can calculate Air-Fuel ratio earlier. ECM commands heater control module switched on or off, so that heated oxygen sensor works within the specified working temperature range. Engine control module detects the temperature by Measure the heater current.

The Post-Catalytic heated oxygen sensor heating coil voltage is provided by The Main Relay, which is controlled by ECM. When the ignition switch is turned to "ON" position, the Post-Catalytic oxygen sensor harness connector EN03 terminal No.1 voltage is provided by the battery. ECM controls heater working time through ECM harness connector EN01 terminal No.4.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0036<br>P0037<br>P0038 | Hardware Circuit Checks | 1. Circuit Open<br>2. Circuit Short to Ground<br>3. Circuit Short to Power Supply | 1. Sensor Circuit<br>2. Sensor<br>3. ECM |
| P0054 | The current resistance is greater than the set value. | 1. The oxygen sensor current internal resistance is greater than 1700 Ω.<br>2. The current exhaust gas temperature is between 200°C (392 ºF) and 550°C (1,022 ºF). | |

3. Schematic:




4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

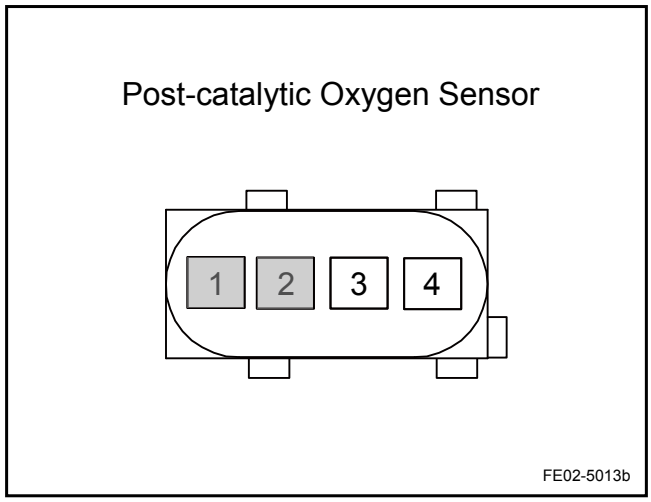
| | |
|---|---|
| Step 1 | Initial Inspection |

Check the existence of following factors that will affect the oxygen sensor working status:

(a) Exhaust system leaks or blockage.
(b) Water entering into heated oxygen sensor connector.
(c) After engine worked in high temperatures, check whether exhaust pipes are too hot.

Next

| | |
|---|---|
| Step 2 | Check the Post-Catalytic oxygen sensor heater resistance. |

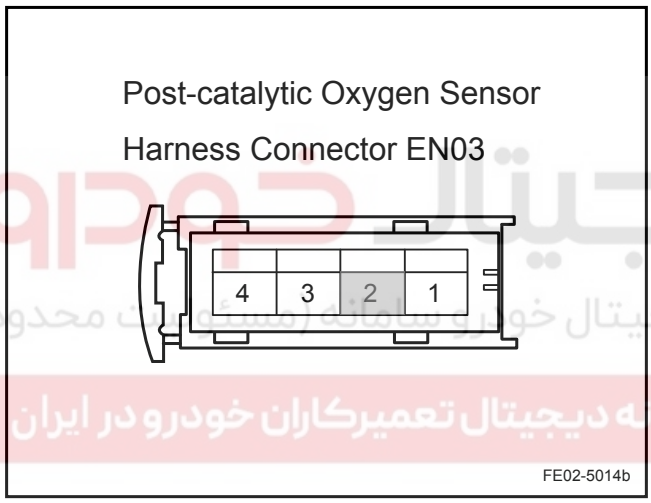



(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the post-catalytic oxygen sensor wiring harness connector.
(c) Measure the Post-Catalytic oxygen sensor heater resistance.
Standard Resistance: Between connector No.1 and No.2, 9 Ω (68 ºF) at 20°C
(d) Connect the post-catalytic oxygen sensor wiring harness connector.
Is the resistance the specified value?

No → Replace oxygen sensor. Refer to 2.4.7.1 Post-Catalytic Oxygen Sensor Replacement

Yes

| | |
|---|---|
| Step 3 | Check the terminal No.2 to ground voltage. |



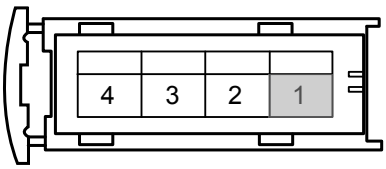

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the post-catalytic oxygen sensor wiring harness connector.
(c) Turn the ignition switch to "ON" position.
(d) Measure the Post-Catalytic oxygen sensor harness connector EN03 terminal No.1 to ground voltage.
Standard Voltage: 11-14 V
(e) Connect the post-catalytic oxygen sensor wiring harness connector EN03.
Is voltage the specified values?

No → The Post-Catalytic oxygen sensor heater power supply circuit malfunction.

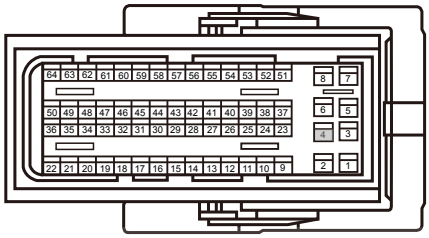
Yes

| | |
|---|---|
| Step 4 | Check the Post-Catalytic oxygen sensor heater control terminal continuity. |

Post-catalytic Oxygen Sensor Harness Connector EN03




ECM Harness Connector EN01



FE02-5015b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the post-catalytic oxygen sensor wiring harness connector EN03.
(c) Disconnect ECM harness connector EN01.
(d) Measure the continuity between the post-catalytic oxygen sensor wiring harness connector EN03 terminal No.2 and ECM harness connector EN01 terminal No.4.

Standard Resistance: Less than 1 Ω

(e) Connect ECM harness connector EN01.
(f) Connect the post-catalytic oxygen sensor wiring harness connector EN03.

Is resistance the specified value?

| | |
|---|---|
| No | ECM control circuit malfunction |

Yes

| | |
|---|---|
| Step 5 | Check ECM working circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

| | |
|---|---|
| No | Repair the faulty part. |

Yes

| | |
|---|---|
| Step 6 | Replace ECM. Refer to 2.2.8.8 Engine Control Module Replacement. |

Next

| | |
|---|---|
| Step 7 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 5 min.
(f) Read control system DTC code again to confirm that the system has no DTC code.

| | |
|---|---|
| No | Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check |

Yes

| | |
|---|---|
| Step 8 | Diagnostic completed. |

5. Repair Instructions:

Replace the post-catalytic oxygen sensor. Refer to 2.4.7.1 Post-Catalytic Oxygen Sensor Replacement.

## 2.2.7.17 DTC P0105 P0106 P0107 P0108

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0105 | Intake Air Pressure Sensor Signal No Change (Frozen) |
| DTC | P0106 | Intake Air Pressure Sensor Unreasonable |
| DTC | P0107 | Intake Air Pressure Sensor Circuit Short to Ground |
| DTC | P0108 | Intake Air Pressure Sensor Circuit Short to Power Supply |

Intake Air Pressure Sensor responds to the pressure changes within the intake manifold. Pressure varies according to engine load. The sensor circuit consists of the following:

- 5V Reference Voltage Circuit
- Low Reference Voltage Circuit
- Sensor Signal Circuit

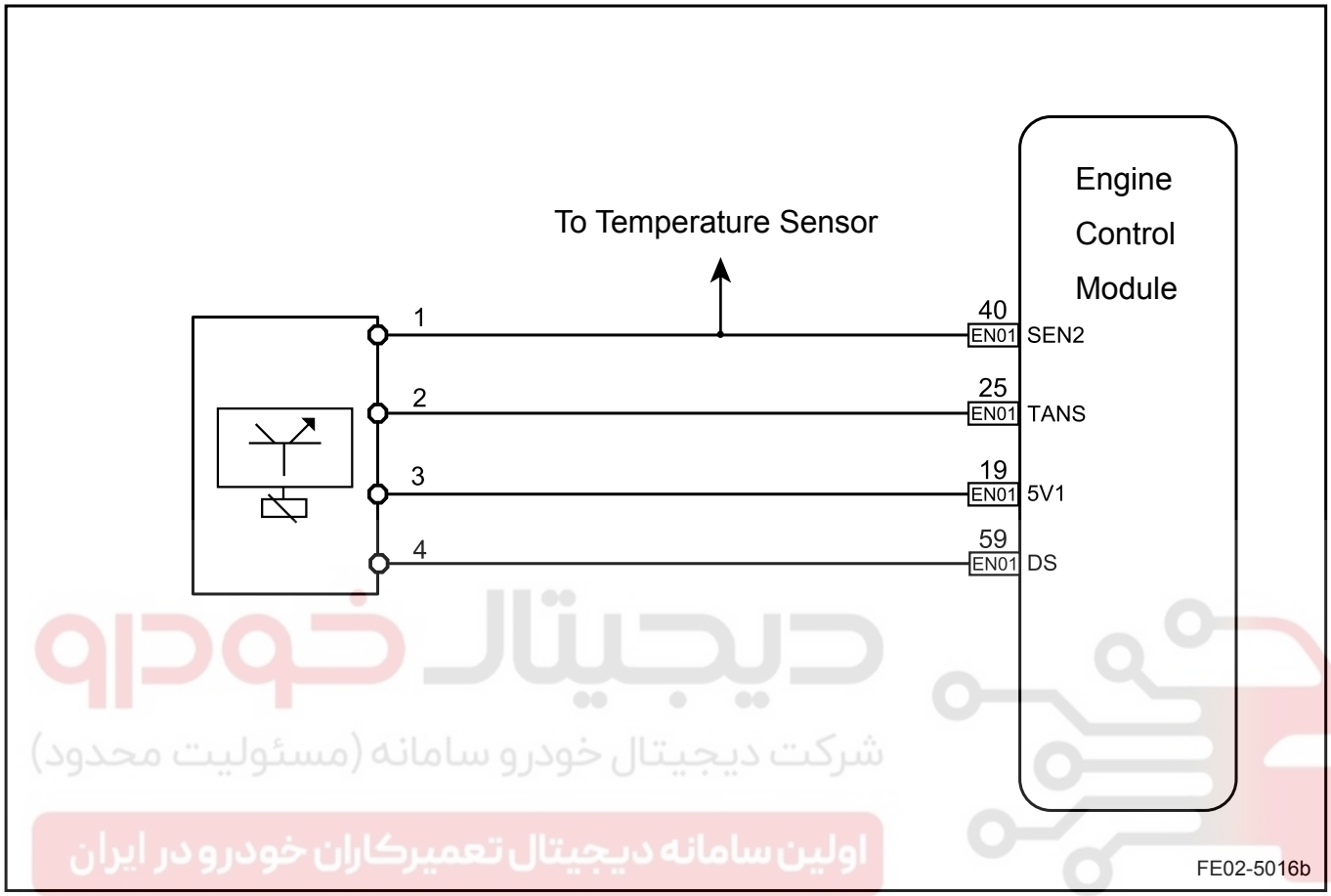
ECM provides EN16 5 V reference voltage through ECM harness connector EN01 terminal No.19 to the sensor harness connector EN16 terminal No.3. At the same time ECM provides a low reference voltage through EN01 terminal No.40 to the sensor harness connector EN16 terminal No.1. The sensor provides a signal through EN16 terminal No.4 to ECM harness connector EN01 terminal No.59, and the signal is related to the intake manifold pressure change. When the intake manifold absolute pressure is low, ECM detected signal voltage will be low, such as at idle or during deceleration. When the intake manifold absolute pressure is high, ECM detected signal voltage will be high, such as when the ignition switch is turned on and the engine is turned off, or when the throttle fully open. Sensors are also used to determine the atmospheric pressure such as When the ignition switch is turned on and the engine is turned off. As long as the engine running with the throttle fully open, atmospheric pressure readings will also be updated. ECM monitors sensor signals in order to determine whether the voltage is beyond the normal range.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0105 | Signal Inspection: The pressure does not decrease after starting. | 1. The pressure drop is less than 2 kPa after starting.<br>2. Engine speed is greater than 800 rpm. | 1. Sensor Circuit<br>2. Sensor<br>3. ECM |
| P0106 | Signal Unreasonable | Pressure Sensor Displayed Pressure. | |
| P0107 | Circuit Inspection, Over the Maximum Limit | Pressure sensor voltage is less than 0.1 V. | |

| | | | |
|---|---|---|---|
| P0108 | Circuit Inspection, Lower Than the Maximum Limit | Pressure sensor voltage is greater than 4.9 V. | |

3. Schematic:




4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Initial Inspection |

Check the existence of the following conditions:

(a) Sensor Housing Damage, Broken Vacuum Tubes.
(b) Sensor Seal Damage.
(c) Sensor Loose or Not Properly Installed.
(d) Sensor Tube blockage.

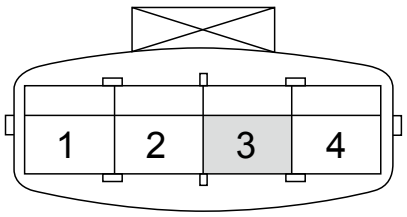
Next

Note

It is not allowed to connect intake manifold absolute pressure sensor 5 V reference voltage circuit and other components of the vehicle, as this will damage the sensors and ECM.

| Step 2 | Measure intake manifold absolute pressure sensor 5 V reference voltage. |
|---|---|

Intake Air Pressure Temperature Sensor Harness Connector EN16




FE02-5017b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect intake manifold absolute pressure sensor wiring harness connector EN16.
(c) Turn the ignition switch to "ON" position.
(d) Measure intake manifold absolute pressure sensor wiring harness connector EN16 terminal No.3 to a reliable ground voltage.

Standard Voltage: 4.5V-5.5V

(e) Connect intake manifold absolute pressure sensor wiring harness connector EN16.

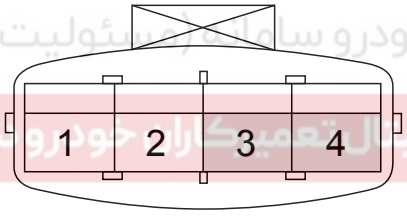
Is voltage the specified value?

No → Go to step 6

Yes

| Step 3 | Measure sensor signal circuit. |
|---|---|

Intake Air Pressure Temperature Sensor Harness Connector EN16




FE02-5018b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect intake manifold absolute pressure sensor wiring harness connector EN16.
(c) Turn the ignition switch to "ON" position.
(d) Between EN16 terminal No.3 and No.4, connect a 5A fuse wire. Use scan tool to read "the actual intake manifold absolute pressure sensor voltage" parameter.

Standard Parameter: 4.5V-5.5V

(e) Connect intake manifold absolute pressure sensor wiring harness connector EN16.

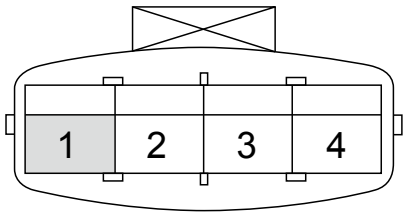
Is data normal?

No → Go to step 7

Yes

| Step 4 | Measure intake manifold absolute pressure sensor ground circuit. |
|---|---|

Intake Air Pressure Temperature Sensor Harness Connector EN16




FE02-5019b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect intake manifold absolute pressure sensor wiring harness connector EN16.
(c) Turn the ignition switch to "ON" position.
(d) Measure resistance between intake manifold absolute pressure sensor wiring harness connector EN16 terminal No. 1 and a reliable ground.

Standard Value: Less than 3 Ω

(e) Connect intake manifold absolute pressure sensor wiring harness connector EN16.

Is resistance normal?

| | |
|---|---|
| No | Go to step 8 |

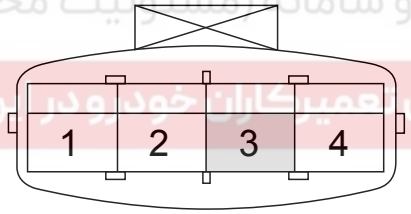
Yes

| | |
|---|---|
| Step 5 | Replace intake manifold absolute pressure sensor. |

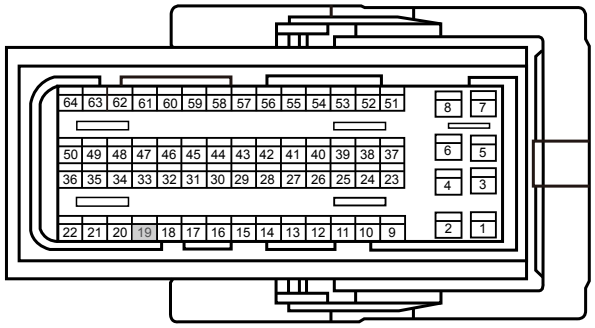
| | |
|---|---|
| Next | Go to step 10 |

| | |
|---|---|
| Step 6 | Check sensor 5 V reference voltage circuit. |

Intake Air Pressure Temperature Sensor Harness Connector EN16




ECM Harness Connector EN01




FE02-5020b

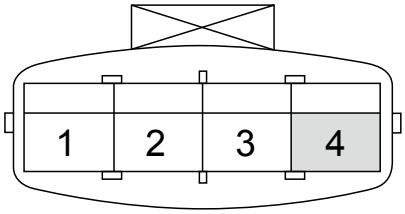
(a) Turn the ignition switch to "OFF" position.
(b) Disconnect intake manifold absolute pressure sensor wiring harness connector EN16.
(c) Disconnect ECM harness connector EN01.
(d) Measure the resistance between intake manifold absolute pressure sensor harness connector EN16 terminal No.3 and ECM harness connector terminal No.19. Check whether the circuit is open. If there is no open circuit, repair the faulty part.
(e) Measure the resistance between intake manifold absolute pressure sensor wiring harness connector EN16 terminal No. 3 and a reliable ground. Check whether there is a circuit short to ground . If there is no short circuit, repair the faulty part.
(f) Measure the voltage value between intake manifold absolute pressure sensor wiring harness connector EN16 terminal No. 3 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN16 (3) and EN01 (19) | Less than 1 Ω |
| Resistance Between EN16 (3) and A Reliable Ground | 10 kΩ or higher |
| Voltage Between EN16 (3) and A Reliable Ground | 0 V |

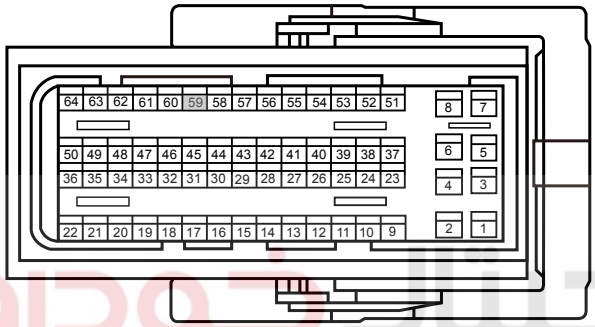
| | |
|---|---|
| Next | Go to step 9 |

| Step 7 | Check sensor signal circuit. |
|---|---|

Intake Air Pressure Temperature Sensor Harness Connector EN16




ECM Harness Connector EN01




FE02-5021b

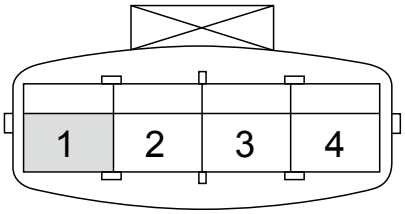
(a) Turn the ignition switch to "OFF" position.
(b) Disconnect intake manifold absolute pressure sensor wiring harness connector EN16.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between intake manifold absolute pressure sensor harness connector EN16 terminal No.4 and ECM harness connector terminal No.59. Check whether the circuit is open. If there is no open circuit, repair faulty part.
(e) Measure resistance between intake manifold absolute pressure sensor harness connector EN16 terminal No.4 and a reliable ground. Check whether the circuit is short to ground. If there is no short circuit, repair faulty part.
(f) Measure voltage between intake manifold absolute pressure sensor harness connector EN16 terminal No.4 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN16 (4) and EN01 (59) | Less than 1 Ω |
| Resistance Between EN16 (4) and A Reliable Ground | 10 kΩ or higher |
| Voltage Between EN16 (4) and A Reliable Ground | 0 V |

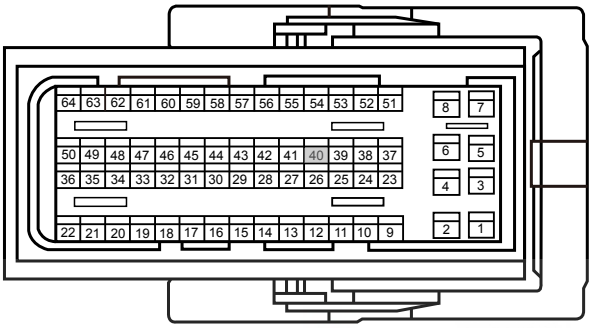
| Normal | Go to step 9 |
|---|---|

| Step 8 | Check sensor ground circuit. |
|---|---|

Intake Air Pressure Temperature Sensor Harness Connector EN16




ECM Harness Connector EN01




FE02-5022b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect intake manifold absolute pressure sensor wiring harness connector EN16.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between intake manifold absolute pressure sensor harness connector EN16 terminal No.1 and ECM harness connector terminal No.40. Check whether the circuit is open. If there is no open circuit, repair the faulty part.
(e) Measure voltage between intake manifold absolute pressure sensor harness connector EN16 terminal No.1 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN16 (1) and EN01 (40) | Less than 1 Ω |
| Voltage Between EN16 (1) and A Reliable Ground | 0 V |

Execute next step as per normal.

Next

| | |
|---|---|
| Step 9 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 10 | Replace ECM. |

Next

| | |
|---|---|
| Step 11 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 12 | Diagnostic completed. |

5. Repair Instructions:

Replace the MAP sensor. Refer to 2.2.8.7 Intake Air Pressure and Temperature Sensor Replacement.

Refer to 2.2.8.8 Engine Control Module ReplacementReplace ECM.

## 2.2.7.18 DTC P0112 P0113

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0112 | Intake Air Temperature Sensor Signal Voltage Too Low |

| | | |
|---|---|---|
| DTC | P0113 | Intake Air Temperature Sensor Signal Voltage Too High |

The sensor is an integrated part of the engine intake pressure sensor for Measure the temperature of air entering the engine. ECM provides 5 V reference voltage through ECM harness connector EN01 terminal No.25 to the intake air pressure and temperature sensor wiring harness connector EN16 terminal No.2. At the same time it provides ECM internal low reference voltage through EN01 terminal No.40 to intake air pressure and temperature sensor EN16 terminal No.1. When the intake air pressure and temperature sensors is cold, the thermistor value used to measure temperature is high. When the air temperature rises, the resistance decreases. When the resistance is higher, ECM will detect the signal circuit with a higher voltage. With the decrease of resistance, ECM detected intake air temperature signal circuit voltage also decreases.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0112<br>P0113 | 1. More Than the Upper Limit<br>2. Less than the Lower Limit | 1. Short to ground. Intake air temperature is higher than 138°C (280.4 ºF).<br>2. Short to power supply. Intake air temperature is less than -38.3°C (-36.9 ºF).<br>3. Startup time more than 240 s.<br>4. Engine idle. | 1. Sensor Circuit<br>2. Sensor<br>3. ECM |

3. Schematic:

Refer to 2.2.7.17 DTC P0105 P0106 P0107 P0108in schematics.

4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Initial Inspection |

Check the existence of the following conditions:

(a) Sensor Housing Damage
(b) Sensor Loose or Not Properly Installed

(c) Sensor Wiring Harness Connector Loose

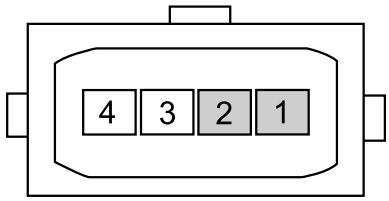
Next

Note

It is not allowed to connect intake manifold absolute pressure sensor 5 V reference voltage circuit and other components of the vehicle, as this will damage the sensors and ECM.

| Step 2 | Measure intake air temperature sensor resistance. |
|---|---|

Intake Air Temperature/Pressure Sensor




FE02-5024b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect intake air pressure and temperature sensor wiring harness connector EN16.
(c) Measure intake air temperature sensor resistance.

Standard Resistance (Refer to the specific parameters2.2.1.2 Temperature Sensor Temperature and Resistance Correlation): 20°C (68 ºF) 2,400 Ω

(d) Connect intake air pressure and temperature sensor wiring harness connector EN16.

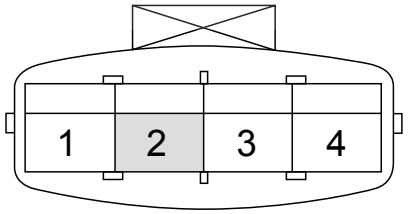
Is resistance the specified value?

No → Replace intake air pressure and temperature sensor. Go to step 9

Yes

| Step 3 | Measure intake air temperature sensor signal. |
|---|---|

Intake Air Pressure Temperature Harness Connector EN16




FE02-5025b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect intake air pressure and temperature sensor wiring harness connector EN16.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between intake air pressure and temperature sensor wiring harness connector EN16 terminal No.2 and a reliable ground.

Standard Voltage: 4.7-5.5 V

(e) Connect intake air pressure and temperature sensors connector EN16.

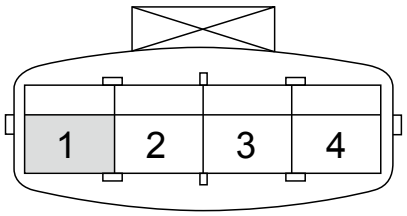
Is voltage normal?

No → Go to step 5

Yes

| Step 4 | Measure intake air temperature sensor to ground circuit. |
|---|---|

Intake Air Pressure Temperature Harness Connector EN16




FE02-5026b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect intake air pressure and temperature sensor wiring harness connector EN16.
(c) Turn the ignition switch to "ON" position.
(d) Measure resistance between intake air pressure and temperature sensor wiring harness connector EN16 terminal No.1 and a reliable ground.

Standard Resistance: Less than 3 Ω

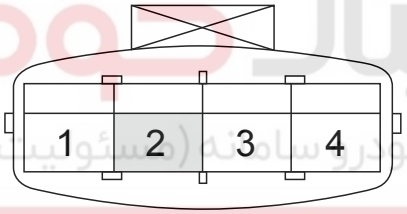
(e) Connect intake air pressure and temperature sensors wiring harness connector EN16.

Is resistance normal?

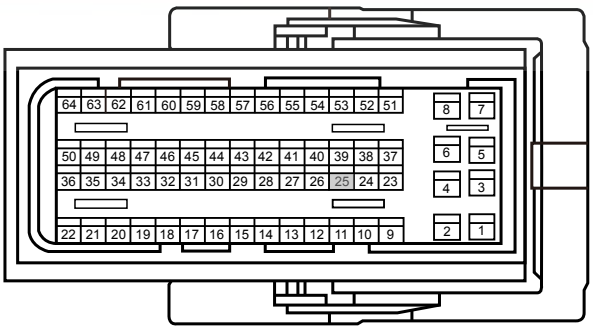
| | |
|---|---|
| No | Go to step 6 |
| Yes | Go to step 7 |

| Step 5 | Check intake air temperature sensor signal circuit. |
|---|---|

Intake Air Pressure Temperature Harness Connector EN16




ECM Harness Connector EN01




FE02-5027b

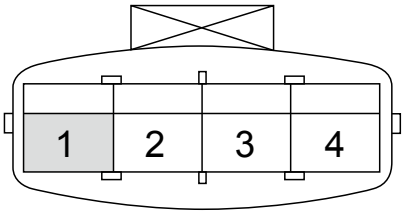
(a) Turn the ignition switch to "OFF" position.
(b) Disconnect intake air pressure and temperature sensor wiring harness connector EN16.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between intake air pressure and temperature sensor wiring harness connector EN16 terminal No.2 and ECM harness connector terminal No.25. Check whether the circuit is open.
(e) Measure resistance between intake air pressure and temperature sensor wiring harness connector EN16 terminal No.2 and a reliable ground. Check whether the circuit is short to ground.
(f) Measure voltage between intake air pressure and temperature sensor wiring harness connector EN16 terminal No.2 and a reliable ground. Check whether the circuit is short to power supply.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN16 (2) and EN01 (25) | Less than 1 Ω |
| Resistance Between EN16 (2) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN16 (2) and a Reliable Ground | 0 V |

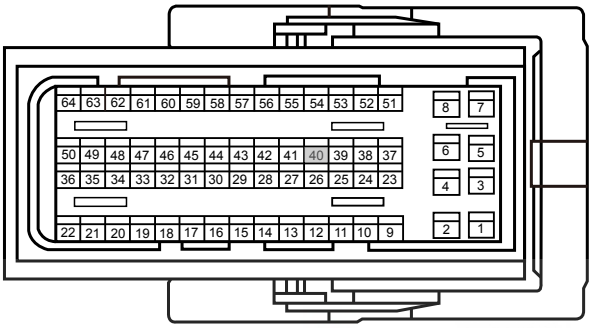
| | |
|---|---|
| Next | Go to step 7 |

| Step 6 | Check intake air temperature sensor ground circuit. |
|---|---|

Intake Air Pressure Temperature Harness Connector EN16




ECM Harness Connector EN01




FE02-5028b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect intake air pressure and temperature sensor wiring harness connector EN16.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between intake air pressure and temperature sensor wiring harness connector EN16 terminal No.1 and ECM harness connector terminal No.40. Check whether the circuit is open. If there is no open circuit,repair the faulty part.
(e) Measure voltage between intake air pressure and temperature sensor wiring harness connector EN16 terminal No.1 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit,repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN16 (1) and EN01 (40) | Less than 1 Ω |
| Voltage Between EN16 (1) and a Reliable Ground | 0 V |

Execute next step as per normal.

Next

| | |
|---|---|
| Step 7 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 8 | Replace ECM. |

Next

| | |
|---|---|
| Step 9 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 10 | Diagnostic completed. |

5. Repair Instructions:

Replace intake air pressure and temperature sensor. Refer to 2.2.8.7 Intake Air Pressure and Temperature Sensor Replacement.

## 2.2.7.19 DTC P0117 P0118

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0117 | Engine Coolant Temperature Sensor Circuit Voltage Too Low |

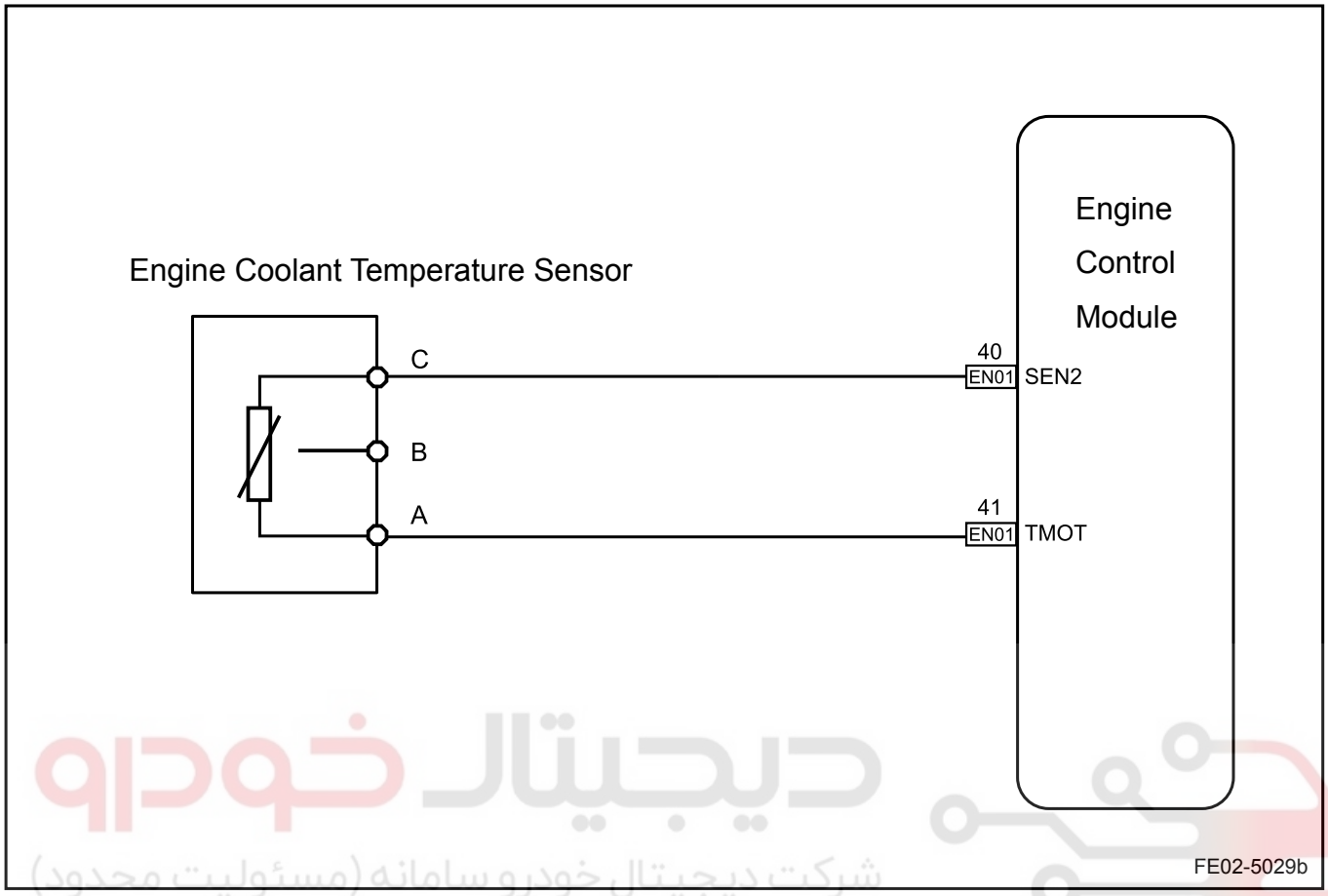
| | | |
|---|---|---|
| DTC | P0118 | Engine Coolant Temperature Sensor Circuit Voltage Too High |

ECT sensor is a variable resistor with negative temperature coefficient and is used to measure engine coolant temperature. ECM provides 5V voltage through ECM harness connector EN01 terminal No.41 ECT sensor harness connector EN23 terminal A. It also provides a low reference voltage through EN01 terminal No.40 to the ECT sensor connector EN23 terminal C. ECM will always record the length of time the ignition switch off. When starting if it reaches the set ignition switch off time, the engine control module will compare the engine coolant temperature and intake air temperature in order to determine whether the temperature difference is within the normal working range.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0117<br>P0118 | 1. More Than the Upper Limit<br>2. Lower Than the Lower Limit | 1. Short to Ground. The engine coolant temperature is higher than 140°C (284 °F).<br>2. Short to power supply. The engine coolant temperature is lower than -37.5°C (-35.5 °F). | 1. Sensor Circuit<br>2. Sensor<br>3. ECM |

3. Schematic:




4. Diagnostic Steps:

Warning!

Refer to "Cooling System Servicing Warning" in "Warnings and Notices".

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

Note

It is not recommended at any time to use flammable anti-freezer, such as alcohol. Combustible anti-freezer can cause serious fires.

| | |
|---|---|
| Step 1 | Initial Inspection |

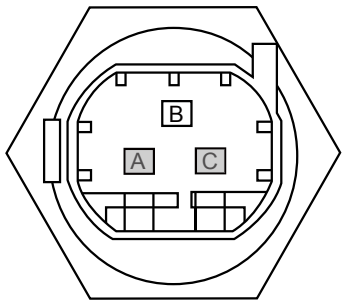
(a) Check the engine coolant temperature sensor whether there is evidence of corrosion, as well as the engine coolant leaking through the sensor.

(b) Check the cooling system whether the engine coolant level is correct.

Next

| | |
|---|---|
| Step 2 | Measure engine coolant temperature sensor resistance. |

Engine Coolant Temperature




FE02-5030b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the engine coolant temperature sensor wiring harness connector EN23.
(c) Measure engine coolant temperature sensor resistance.

Standard Resistance (Refer to the specific parameters2.2.1.2 Temperature Sensor Temperature and Resistance Correlation): 2400 Ω (68 °F) at 20°C

(d) Connect the engine coolant temperature sensor wiring harness connector EN23.

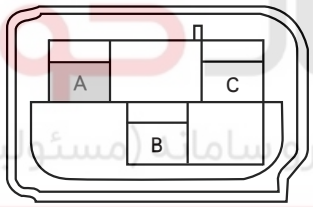
Is resistance the specified value?

No → Replace the engine coolant temperature sensor. Go to step 9

Yes

| Step 3 | Measure engine coolant temperature sensor signal circuit. |
|---|---|

Engine Coolant Temperature Sensor Harness Connector EN23




FE02-5031b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the engine coolant temperature sensor wiring harness connector EN23.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between engine coolant temperature sensor EN23 terminal A and a reliable ground.

Standard Voltage: 4.7-5.5 V

(e) Connect the engine coolant temperature sensor wiring harness connector EN23.

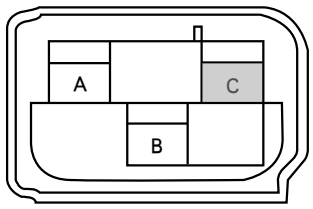
Is voltage normal?

No → Go to step 5

Yes

| Step 4 | Measure engine coolant temperature sensor ground circuit. |
|---|---|

Engine Coolant Temperature Sensor Harness Connector EN23




FE02-5032b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the engine coolant temperature sensor wiring harness connector EN23.
(c) Turn the ignition switch to "ON" position.
(d) Measure resistance between engine coolant temperature sensor wiring harness connector EN23 terminal No.C and a reliable ground.

Standard Resistance: Less than 3 Ω

(e) Connect the engine coolant temperature sensor wiring harness connector EN23.

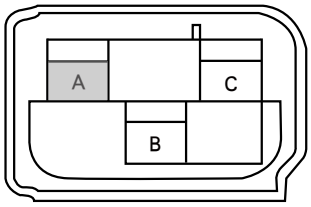
Is resistance normal?

No → Go to step 6

Yes → Go to step 7

| Step 5 | Check the engine coolant temperature sensor signal circuit. |
|---|---|

Engine Coolant Temperature Sensor Harness Connector EN23




ECM Harness Connector EN01


FE02-5033b

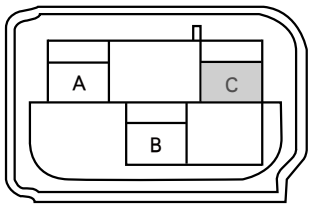
(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the engine coolant temperature sensor wiring harness connector EN23.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between engine coolant temperature sensor wiring harness connector EN23 terminal A and ECM harness connector terminal No.41. Check whether the circuit is open.
(e) Measure resistance between engine coolant temperature sensor wiring harness connector EN23 terminal A and a reliable ground. Check whether the circuit is short to ground.
(f) Measure voltage between engine coolant temperature sensor wiring harness connector EN23 terminal A and a reliable ground. Check whether the circuit is short to power supply.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN23 (A) and EN01 (41) | Less than 1 Ω |
| Resistance Between EN23 (A) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN23 (A) and a Reliable Ground | 0 V |

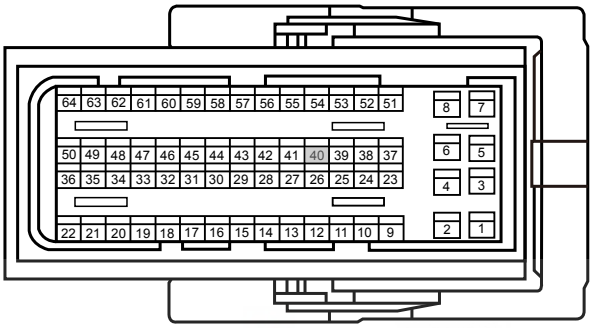
Next → Go to step 7

| Step 6 | Check the engine coolant temperature sensor ground circuit. |
|---|---|

Engine Coolant Temperature Sensor Harness Connector EN23




ECM Harness Connector EN01




FE02-5034b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the engine coolant temperature sensor wiring harness connector EN23.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between engine coolant temperature sensor wiring harness connector EN23 terminal C and ECM harness connector terminal No.40. Check whether the circuit is open. If there is no open circuit, repair the faulty part.
(e) Measure voltage between engine coolant temperature sensor wiring harness connector EN23 terminal C and a reliable ground. Check whether there is a short circuit. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN23 (C) and EN01 (40) | Less than 1 Ω |
| Voltage Between EN23 (C) and a Reliable Ground | 0 V |

Execute next step as per normal.

Next

| | |
|---|---|
| Step 7 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 8 | Replace ECM. |

Next

| | |
|---|---|
| Step 9 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 10 | Diagnostic completed. |

5. Repair Instructions:

Replace the engine coolant temperature sensor. Refer to 2.2.8.6 Engine Coolant Temperature Sensor Replacement.

## 2.2.7.20 DTC P0122 P0123

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0122 | Throttle Position Sensor Circuit Voltage Lower Than Minimum |

| | | |
|---|---|---|
| DTC | P0123 | Throttle Position Sensor Circuit Voltage Higher Than Maximum |

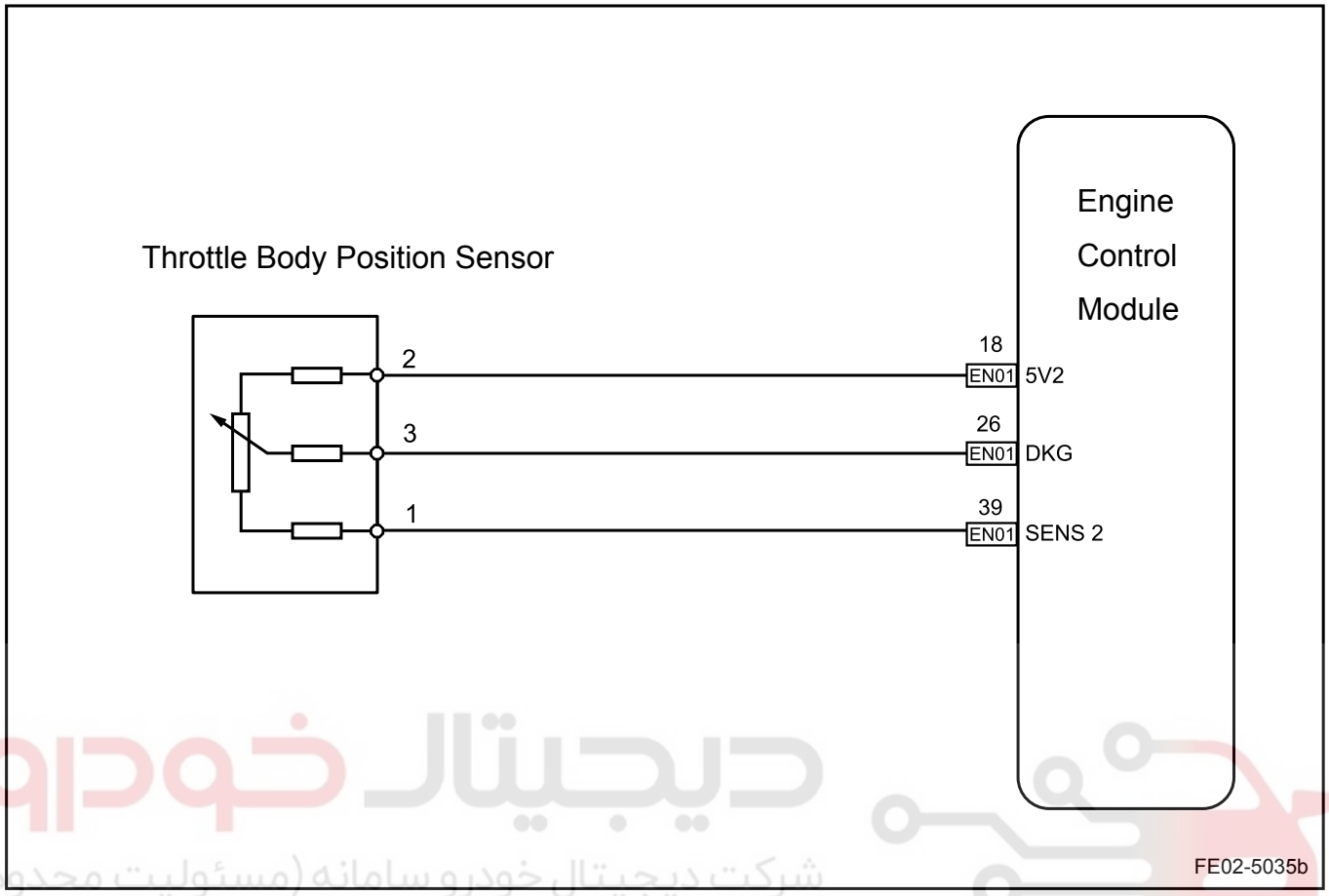
The actual throttle position will be compared with throttle position determined by the engine load. Engine Control Module (ECM) detects the engine load by intake manifold absolute pressure sensor (MAP) signal. After further comparison, ECM determines whether there is a sensor fault and set the corresponding DTC codes.

- ECM provides 5 V reference voltage through ECM harness connector EN01 terminal No.39 to TPS sensor harness connector EN27 terminal No.1.
- TPS provides sensor signal voltage through EN27 terminal No.3 to ECM harness connector EN01 terminal No.26.
- ECM provides low reference voltage through ECM harness connector EN01 terminals No.14 and No.18 to TPS sensor harness connector EN27 terminal No.2.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0122<br>P0123 | 1. Higher Than Throttle Position and Angle Signals Maximum Limit<br>2. Lower Than Throttle Position and Angle Signals Minimum Limit | 1. Throttle Position angle signal is greater than 99%.<br>2. Throttle Position angle signal is less than 1.2%.<br>3. Engine speed is greater than 800 rpm. | 1. Sensor Circuit<br>2. Sensor<br>3. ECM |

3. Schematic:




4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

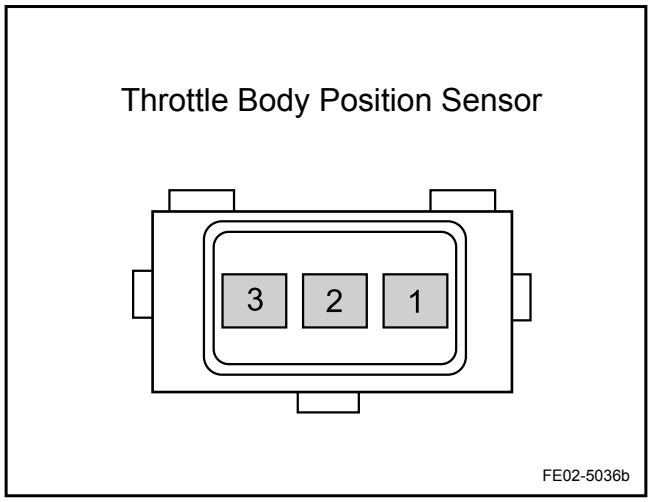
| | |
|---|---|
| Step 1 | Initial Inspection |

(a) Check whether there is a loose sensor wiring harness connector.

(b) Check whether a damages sensor.

Next

| | |
|---|---|
| Step 2 | Measure throttle position sensor resistance. |




(a) Turn the ignition switch to "OFF" position.
(b) Disconnect throttle position sensor wiring harness connector EN27.
(c) Measure throttle position sensor resistance.

| Test Items | Standard Resistance Value |
|---|---|
| Terminal 1 and Terminal 2 | 3,000 Ω |
| Terminal 2 and Terminal 3 | Changes between 1,300 Ω and 2,900 Ω |

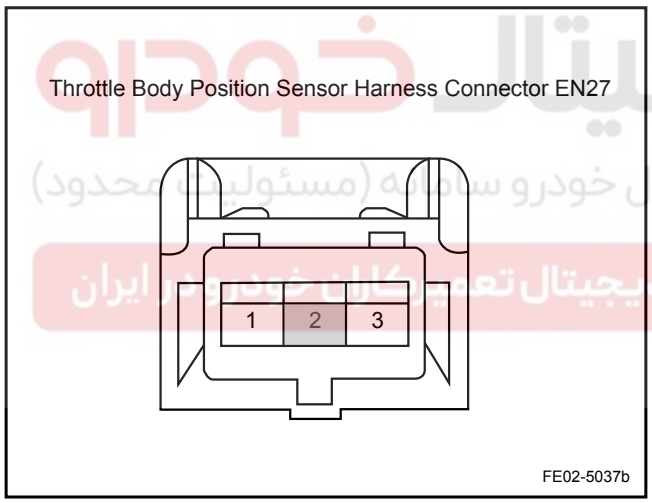
(d) Connect throttle position sensor wiring harness connector EN27.

Is resistance the specified value?

No → Replace throttle position sensor. Go to step 11

Yes

| | |
|---|---|
| Step 3 | Measure throttle position sensor 5 V reference voltage. |




(a) Turn the ignition switch to "OFF" position.
(b) Disconnect throttle position sensor wiring harness connector EN27.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between throttle position sensor EN27 terminal No.2 and a reliable ground.

Standard Voltage: 4.5-5.5 V

(e) Connect throttle position sensor wiring harness connector EN27.

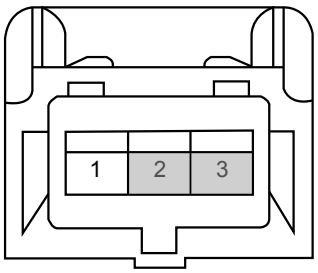
Is voltage the specified value?

No → Go to step 6

Yes

| | |
|---|---|
| Step 4 | Measure throttle position sensor signal circuit. |

Throttle Body Position Sensor
Harness Connector EN27




FE02-5038b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect throttle position sensor wiring harness connector EN27.
(c) Turn the ignition switch to "ON" position.
(d) Connect a 5A fuse between EN27 terminal No.2 and No.3. Use scan tool to read "the actual throttle position sensor voltage" parameter.

Standard Voltage: 4.5-5.5 V

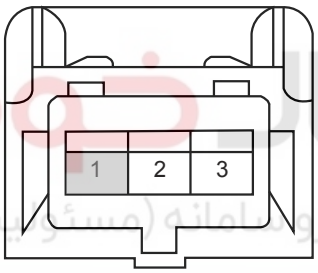
(e) Connect throttle position sensor wiring harness connector EN27.

Is data normal?

| | |
|---|---|
| No | Go to step 7 |

| | |
|---|---|
| Step 5 | Measure throttle position sensor ground circuit. |

Throttle Body Position Sensor
Harness Connector EN27




FE02-5039b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect throttle position sensor wiring harness connector EN27.
(c) Measure resistance between throttle position sensor wiring harness connector EN27 terminal No.1 and a reliable ground.

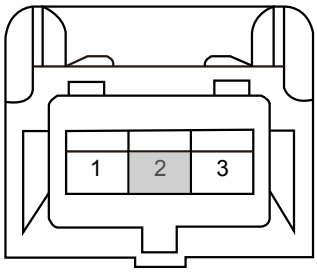
Standard Resistance: Less than 1 Ω

(d) Connect throttle position sensor wiring harness connector EN27.

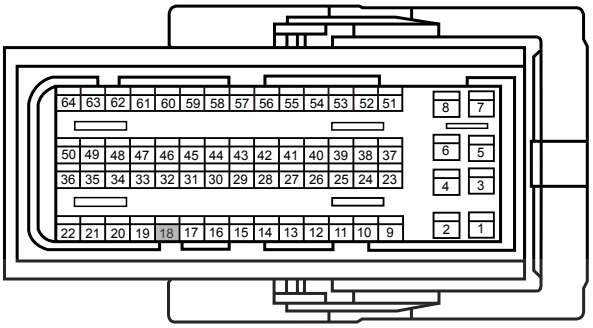
| | |
|---|---|
| No | Go to step 8 |
| Yes | Go to step 9 |

| | |
|---|---|
| Step 6 | Check throttle position sensor 5 V reference voltage circuit. |

Throttle Body Position Sensor Harness Connector EN27




ECM Harness Connector EN01




FE02-5040b

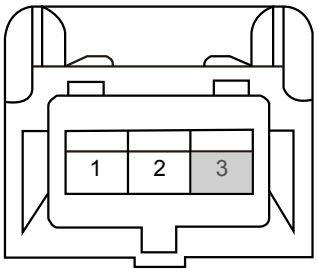
(a) Turn the ignition switch to "OFF" position.
(b) Disconnect throttle position sensor wiring harness connector EN27.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between throttle position sensor wiring harness connector EN27 terminal No.2 and ECM harness connector terminal No.18. check whether there is open circuit. If there is no open circuit, repair the faulty part.
(e) Measure resistance between throttle position sensor wiring harness connector EN27 terminal No.2 and a reliable ground. Check whether the circuit is short to ground. If there is no short circuit, repair the faulty part.
(f) Measure voltage between throttle position sensor wiring harness connector EN27 terminal No.2 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN27 (2) and EN01 (18) | Less than 1 Ω |
| Resistance Between EN27 (2) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN27 (2) and a Reliable Ground | 0 V |

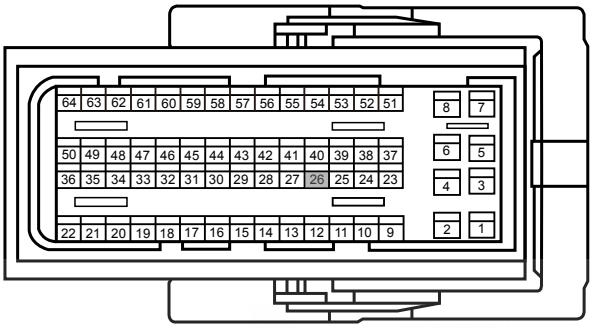
| | |
|---|---|
| Normal | Go to step 9 |

| | |
|---|---|
| Step 7 | Check throttle position sensor signal circuit. |

Throttle Body Position Sensor Harness Connector EN27




ECM Harness Connector EN01




FE02-5041b

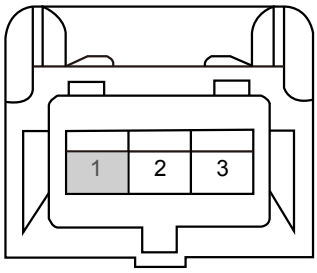
(a) Turn the ignition switch to "OFF" position.
(b) Disconnect throttle position sensor wiring harness connector EN27.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between throttle position sensor wiring harness connector EN27 terminal No.3 and ECM harness connector terminal No.26. Check whether the circuit is open. If there is no open circuit, repair the faulty part.
(e) Measure resistance between throttle position sensor wiring harness connector EN27 terminal No.3 and a reliable ground. Check whether the circuit is short to ground. If there is no short circuit, repair the faulty part.
(f) Measure voltage between throttle position sensor wiring harness connector EN27 terminal No.3 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN27 (3) and EN01 (26) | Less than 1 Ω |
| Resistance Between EN27 (3) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN27 (3) and a Reliable Ground | 0 V |

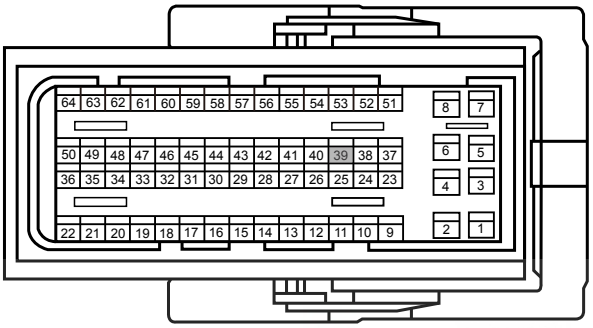
| | |
|---|---|
| Normal | Go to step 9 |

| | |
|---|---|
| Step 8 | Check throttle position sensor ground circuit. |

Throttle Body Position Sensor Harness Connector EN27




ECM Harness Connector EN01




FE02-5042b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect throttle position sensor wiring harness connector EN27.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between throttle position sensor wiring harness connector EN27 terminal No.1 and ECM harness connector terminal No.39. Check whether the circuit is open. If there is no open circuit, repair the faulty part.
(e) Measure voltage between throttle position sensor wiring harness connector EN27 terminal No.1 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN27 (3) and EN01 (39) | Less than 1 Ω |
| Voltage Between EN27 (3) and a Reliable Ground | 0 V |

Execute next step as per normal.

Next

| | |
|---|---|
| Step 9 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 10 | Replace ECM. |

Next

| | |
|---|---|
| Step 11 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 12 | Diagnostic completed. |

5. Repair Instructions:

Replace throttle position sensor. Refer to 2.2.8.3 Throttle Position Sensor Replacement.

## 2.2.7.21 DTC P0130 P0131 P0132 P0133 P0134 P2195 P2196

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0130 | Pre-Catalytic Oxygen Sensor Signal Unreasonable |
| DTC | P0131 | Pre-Catalytic Oxygen Sensor Circuit Voltage Too Low |
| DTC | P0132 | Pre-Catalytic Oxygen Sensor Circuit Voltage Too High |
| DTC | P0133 | Pre-Catalytic Oxygen Sensor Aging |
| DTC | P0134 | Pre-Catalytic Oxygen Sensor Malfunction |
| DTC | P2195 | Pre-Catalytic Oxygen Sensor Aging (Too Lean) |
| DTC | P2196 | Pre-Catalytic Oxygen Sensor Aging (Too Rich) |

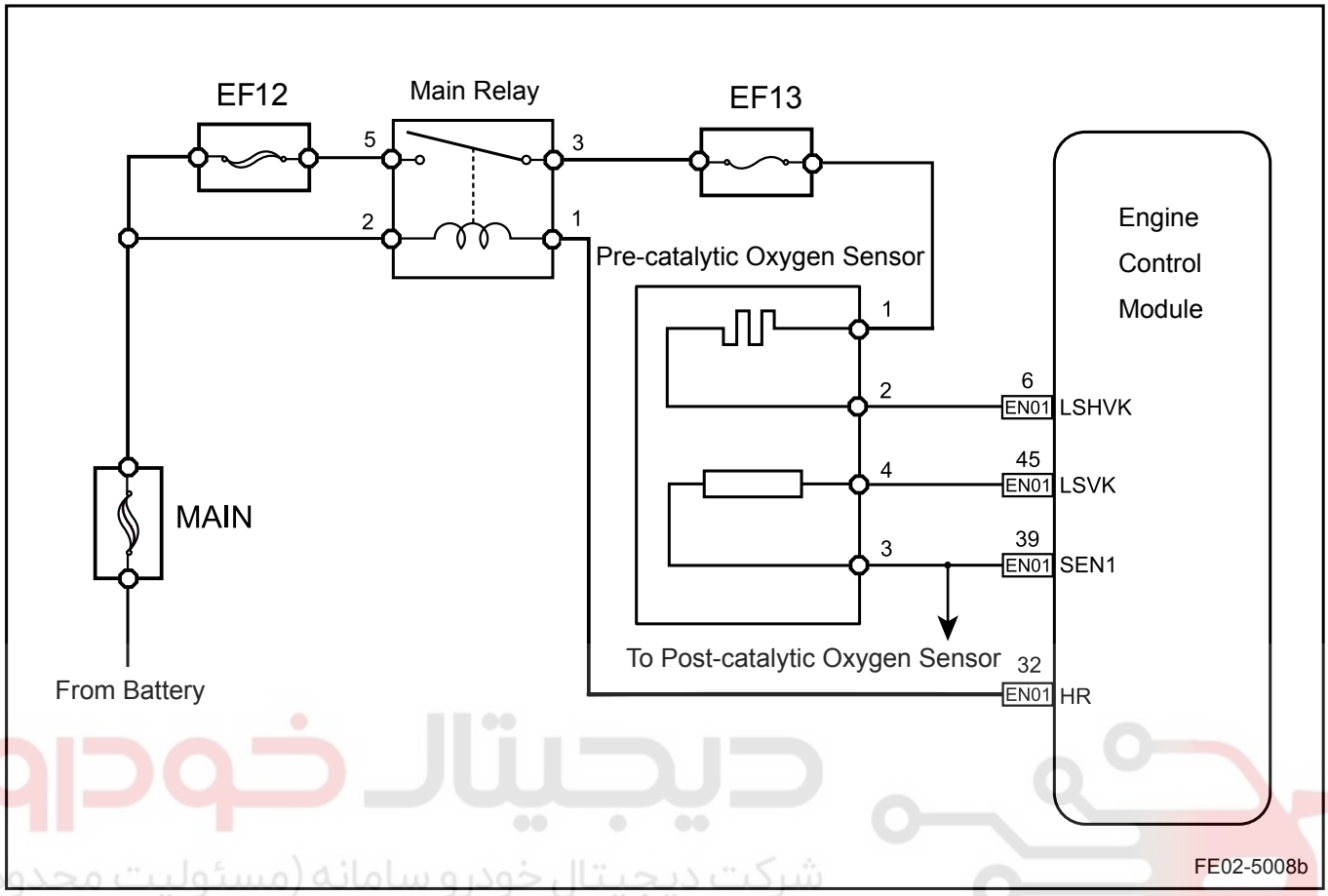
After the vehicle is started, the control module works in the open-loop mode and ignores pre-catalytic oxygen sensor signal voltage when calculating air-fuel ratio. The control module provides approximately 450mV reference voltage to the pre-catalytic oxygen sensor. When the engine starts running, the pre-catalytic oxygen sensor will be heated and begin to generate a 0-0.1 V voltage. This voltage fluctuates. Once the control module detects that the pre-catalytic oxygen sensor voltage exceeds a threshold voltage, it will immediately enter into the closed-loop mode. Control module determines the Air-Fuel ratio using the received pre-catalytic oxygen sensor voltage signal. If the pre-catalytic oxygen sensor voltage increases to over the reference voltage (tend to 1 V), it indicates that the air fuel mixture is too rich. If the pre-catalytic oxygen sensor voltage decreases to below the reference voltage (tend to 0 mV), it indicates that the air fuel mixture is too lean.
ECM provides a signal through ECM harness connector EN01 terminal No.45 to pre-catalytic oxygen sensor wiring harness connector EN02 terminal No.4; a low internal reference voltage through ECM harness connector EN01 terminal No.39 to Pre-Catalytic oxygen sensor wiring harness connector EN02 terminal No.3.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0130 | 1. Pre-Catalytic Oxygen Sensor Voltage Too Low In an Extended Period of Time<br>2. Short to Ground When Cold<br>3. Pre-Catalytic Oxygen Sensor Voltage Leakage | 1. Pre-Catalytic oxygen sensor output voltage is between 0.06-0.40 V.<br>2. Pre-Catalytic oxygen sensor output voltage is less than 0.06 V.<br>3. Pre-Catalytic oxygen sensor output voltage is greater than 0.611 V and less than 1.5 V and Post-Catalytic oxygen sensor output voltage is 0.099 V. | 1. Sensor Circuit<br>2. Sensor<br>3. ECM |

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0131<br>P0132 | 1. Pre-Catalytic Sensor Voltage Too High<br>2. Pre-Catalytic Sensor Voltage Too Low | 1. Pre-Catalytic oxygen sensor output voltage is greater than 1.5 V.<br>2. Pre-Catalytic oxygen sensor output voltage is less than 0.06 V.<br>3. Battery voltage is greater than 10.98 V.<br>4. Engine speed is greater than 25 rpm.<br>5. Exhaust temperature is less than the upper limit 800°C (1,472 ºF).<br>6. Exhaust is hot enough. | |
| P0134 | 1. Signal circuit open.<br>2. Pre-Catalytic Oxygen Sensor High Resistance At High Temperature | 1. Sensor voltage is between 0.401 V and 0.601 V.<br>2. Sensor resistance is greater than 20,000 Ω.<br>3. Oxygen sensor is hot enough, lasting for 100 s. | |
| P0133<br>P2195<br>P2196 | 1. Post-Catalytic oxygen sensor control integral value is over maximum limit.<br>2. Post-Catalytic oxygen sensor control integral value is lower than minimum limit.<br>3. Filtered Pre-Catalytic oxygen sensor signal is greater than specified value. | 1. Post-Catalytic oxygen sensor control integral value is greater than 1.0 s.<br>2. Post-Catalytic oxygen sensor control integral value is less than -1.0 s.<br>3. Diagnostic function is switched on.<br>4. Filtered pre-catalytic oxygen sensor signal cycle is more than 3.3 s.<br>5. Effective cycle count value is greater than 20.<br>6. Target excess air coefficient is equal to 1.<br>7. No pressure sensor malfunction.<br>8. No coolant temperature sensor malfunction.<br>9. No intake air temperature sensor malfunction.<br>10. No diagnosis preventing conditions.<br>11. Speed is between 1,600 rpm and 2,600 rpm.<br>12. Load is between 25 and 50.<br>13. Exhaust temperature model value is greater than 500.<br>14. No pre-catalytic oxygen sensor malfunction.<br>15. No three-way catalytic converter malfunction. | 1. Sensor Circuit<br>2. Sensor<br>3. Mixture Too Rich<br>4. Mixture Too Lean<br>5. ECM |

3. Schematic:




4. Diagnostic Steps:

| | |
|---|---|
| Step 1 | Connect scan tool. |

Next

| | |
|---|---|
| Step 2 | Start engine and turn on the scan tool. |

Next

| | |
|---|---|
| Step 3 | Maintain engine speed at 2,500 rpm for more than 2 min to warm up the engine, until the engine coolant temperature reaches 80°C (176 ºF). |

Next

| | |
|---|---|
| Step 4 | Select on scan tool: Engine/Read data stream/group 1 oxygen sensor voltage 1 (Pre-Catalytic oxygen sensors). |

Next

| | |
|---|---|
| Step 5 | Observe the oxygen sensor output voltage, the data should fluctuate within 0.1-0.8 V. |

Yes → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

No

| | |
|---|---|
| Step 6 | Test the oxygen sensor signal. |

(a) If the voltage data is consistently below 0.45 V (mixture too lean), then carry out inspection steps as following:
- Spray proper amount of propane gas into the intake port.
- Inspect whether the pre-catalytic oxygen sensor voltage data has a significant change, in which case the signal voltage will increase rapidly.

(b) If the voltage data is consistently higher than 0.45 V (mixture too rich), then carry out inspection steps as following:
- Put gear into Neutral.
- Apply hand brake.
- Press the accelerator pedal so the engine speed suddenly increases to 4,000 rpm and then quickly release the accelerator pedal.
- Repeat the previous steps more than 3 times.
- Inspect whether the pre-catalytic oxygen sensor voltage data has a significant change, in which case the signal voltage will decrease rapidly.

During the above test, the pre-catalytic oxygen sensor signal voltage should change significantly.

Is voltage changed significantly?

Yes → Inspect the cause for engine air-fuel ratio too lean/too rich. Refer to 2.2.7.4 Fault Symptom Table.

No

| | |
|---|---|
| Step 7 | Check and confirm no other control system DTC codes. |

(a) Connect scan tool to a datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Press the scan tool power button.
(d) Select the following menu items: Engine/Read DTC codes.
(e) Read DTC codes.

Results:

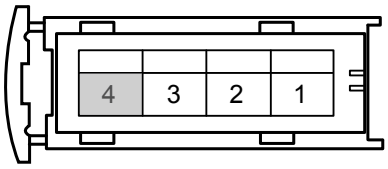
| DTC Codes Shown | To Step |
|---|---|
| DTC codes other than P0030, P0031, P0032, P0053 | No |
| P0030, P0031, P0032, P0053 | Yes |

No → Refer to 2.2.7.11 DTC Code Index

Yes

| Step 8 | Measure pre-catalytic oxygen sensor signal circuit. |
|---|---|

Pre-catalytic Oxygen Sensor Harness Connector EN02




FE02-5043b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect oxygen sensor wiring harness connector EN02.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between Pre-Catalytic oxygen sensor wiring harness connector EN02 terminal No.4 and a reliable ground.

Standard Voltage: 0.35-0.5 V

(e) Connect the pre-catalytic oxygen sensor wiring harness connector EN02.

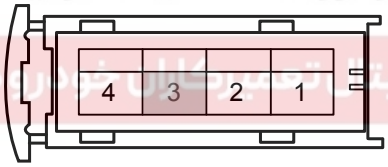
Is voltage the specified value?

No → Go to step 11

Yes

| Step 9 | Measure the pre-catalytic oxygen sensor ground circuit. |
|---|---|

Pre-catalytic Oxygen Sensor Harness Connector EN02




FE02-5044b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect oxygen sensor wiring harness connector EN02.
(c) Turn the ignition switch to "ON" position.
(d) Measure resistance between pre-catalytic oxygen sensor connector EN02 terminal No.3 and a reliable ground.

Standard Resistance: Less than 1 Ω

(e) Connect pre-catalytic oxygen sensor wiring harness connector EN02.

Is resistance the specified value?

No → Go to step 12

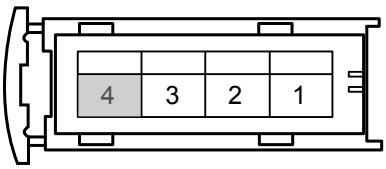
Yes

| Step 10 | Replace the pre-catalytic oxygen sensor. Refer to 2.4.7.2 Pre-Catalytic Oxygen Sensor Replacement. |
|---|---|

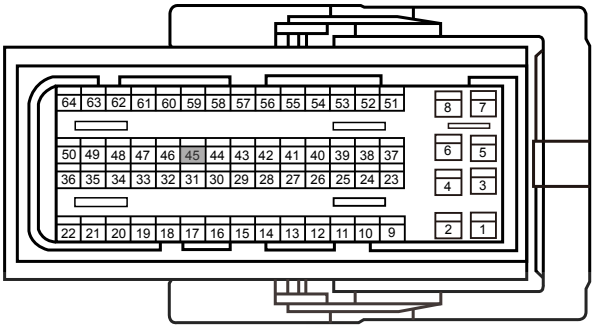
Next → Go to step 15

| Step 11 | Check the pre-catalytic oxygen sensor signal circuit. |
|---|---|

Pre-catalytic Oxygen Sensor Harness Connector EN02




ECM Harness Connector EN01




FE02-5045b

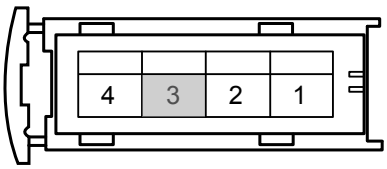
(a) Turn the ignition switch to "OFF" position.
(b) Disconnect oxygen sensor wiring harness connector EN02.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between pre-catalytic oxygen sensor wiring harness connector EN02 terminal No.4 and ECM harness connector terminal No.45. Check whether the circuit is open. If there is no open circuit, repair the faulty part.
(e) Measure resistance between pre-catalytic oxygen sensor wiring harness connector EN02 terminal No.4 and a reliable ground. Check whether the circuit is short to ground. If there is no short circuit, repair the faulty part.
(f) Measure voltage between Pre-Catalytic oxygen sensor wiring harness connector EN02 terminal No.4 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN02 (4) and EN01 (45) | Less than 1 Ω |
| Resistance Between EN02 (4) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN02 (4) and a Reliable Ground | 0 V |

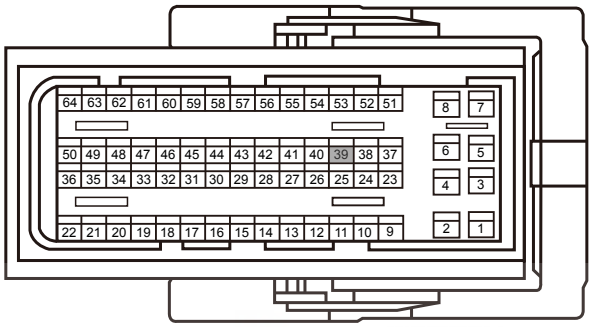
| | |
|---|---|
| Normal | Go to step 15 |

| | |
|---|---|
| Step 12 | Check the pre-catalytic oxygen sensor ground circuit. |

Pre-catalytic Oxygen Sensor Harness Connector EN02




ECM Harness Connector EN01




FE02-5046 b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect oxygen sensor wiring harness connector EN02.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between the oxygen sensor wiring harness connector EN02 terminal No.3 and ECM harness connector terminal No.39. Check whether the circuit is open. If there is no open circuit, repair the faulty part.
(e) Measure resistance between pre-catalytic oxygen sensor wiring harness connector EN02 terminal No.3 and a reliable ground. Check whether the circuit is short to ground. If there is no short circuit, repair the faulty part.
(f) Measure voltage between pre-catalytic oxygen sensor wiring harness connector EN02 terminal No.3 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN02 (3) and EN01 (39) | Less than 1 Ω |
| Resistance Between EN02 (3) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN02 (3) and a Reliable Ground | 0 V |

Execute next step as per normal.

Next

| | |
|---|---|
| Step 13 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 14 | Replace ECM. |

Next

| | |
|---|---|
| Step 15 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 10 min.
(f) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 16 | Diagnostic completed. |

5. Repair Instructions:

Replace the pre-catalytic oxygen sensor. Refer to 2.4.7.2 Pre-Catalytic Oxygen Sensor Replacement.

## 2.2.7.22 DTC P0136 P0137 P0138 P0140 P2270 P2271

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0136 | Post-Catalytic Oxygen Sensor Unreasonable |
| DTC | P0137 | Post-Catalytic Oxygen Sensor Circuit Voltage Too Low |
| DTC | P0138 | Post-Catalytic Oxygen Sensor Circuit Voltage Too High |
| DTC | P0140 | Post-Catalytic Oxygen Sensor Circuit Malfunction |
| DTC | P2270 | Post-Catalytic Oxygen Sensor Aging (Tool Lean) |
| DTC | P2271 | Post-Catalytic Oxygen Sensor Aging (Too Rich) |

After the vehicle is started, the control module works in the open-loop mode and ignores heated oxygen sensor signal voltage when calculating air-fuel ratio. The control module provides approximately 450mV reference voltage to the heated oxygen sensor. When the engine starts running, the heated oxygen sensor will be heated and begin to generate a 0-0.1V voltage. This voltage fluctuates. Once the control module detects that the heated oxygen sensor voltage exceeds a threshold voltage, it will immediately enter into the closed-loop mode. Control module determines the air-fuel ratio using the received heated oxygen sensor voltage signal. If the heated oxygen sensor voltage increases to over the reference voltage (tend to 1V), it indicates that the air fuel mixture is too rich. If the heated oxygen sensor voltage decreases to below the reference voltage (tend to 0mV), it indicates that the air fuel mixture is too lean.

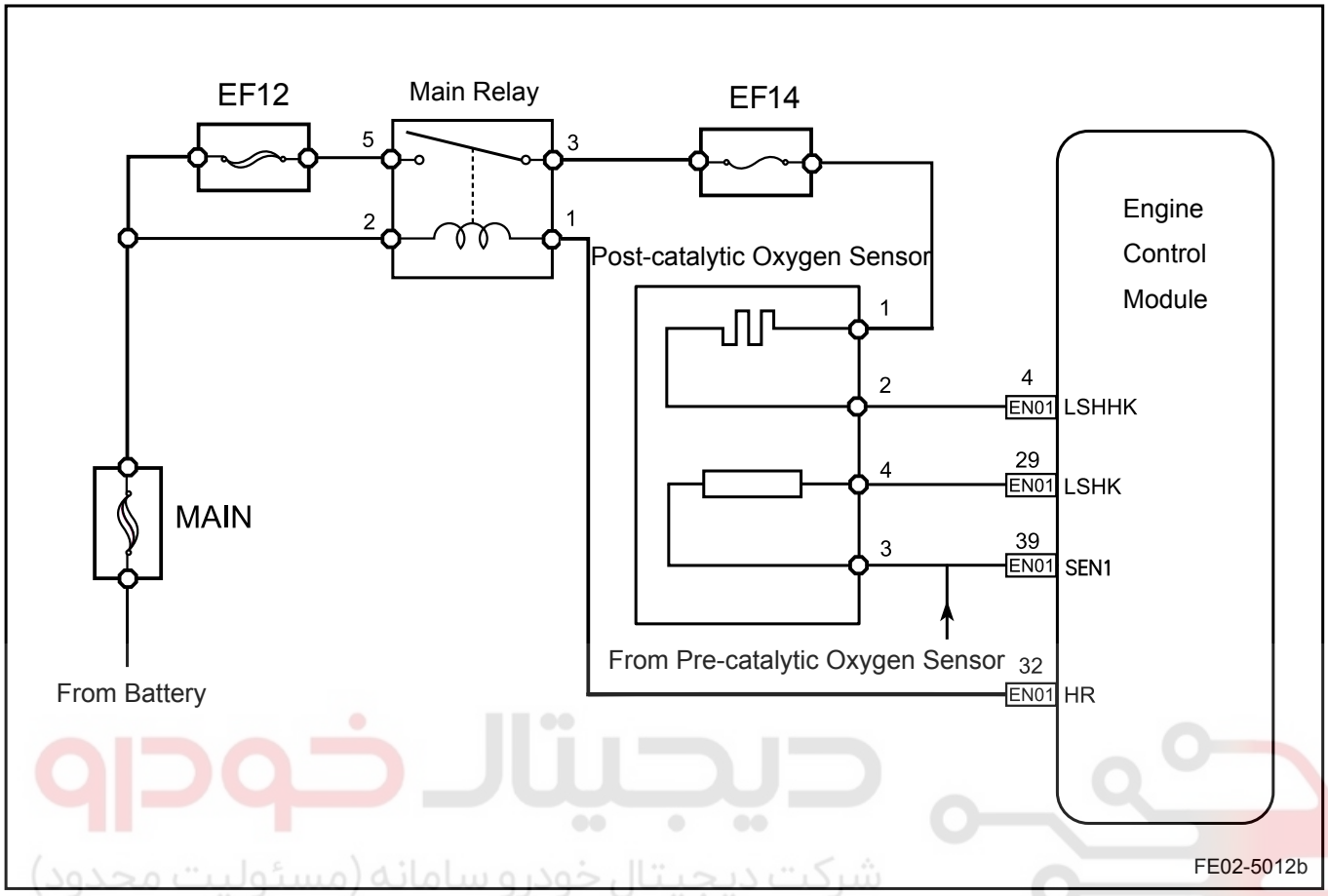
- ECM provides a signal through ECM harness connector EN01 terminal No.29 to post-catalytic oxygen sensor wiring harness connector EN03 terminal No.4.
- ECM provides a low reference voltage through ECM harness connector EN01 terminal No.39 to pre-catalytic oxygen sensor wiring harness connector EN03 terminal No.3.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0136<br>P0137 | Short to Ground When Cold | 1. Post-Catalytic oxygen sensor voltage is less than 0.06 V.<br>2. Post-Catalytic oxygen sensor reaches the normal working temperature. | 1. Sensor Circuit<br>2. Sensor<br>3. Mixture Too Rich<br>4. Mixture Too Lean |

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0138 | Post-Catalytic Oxygen Sensor Voltage Too High | 1. Post-Catalytic oxygen voltage signal is greater than 1.5 V.<br>2. Battery voltage is greater than 10.98 V.<br>3. Engine speed is greater than 25 rpm.<br>4. Target excess air coefficient is equal to 1.<br>5. Three-way catalytic converter temperature is higher than 320°C (608 ºF).<br>6. Battery voltage is greater than 10.98 V.<br>7. Post-Catalytic oxygen sensor reaches the normal working temperature. | 5. Three-way Catalytic Converter<br>6. ECM |
| P0140 | 1. Oxygen Sensor Signal Circuit Open<br>2. Oxygen Sensor With High Resistance at High Temperature | 1. Post-Catalytic oxygen sensor voltage is between 0.42 V and 0.5 V.<br>2. Post-Catalytic oxygen sensor resistance is greater than 40,000 Ω.<br>3. Post-Catalytic oxygen sensor reaches the normal working temperature. | 1. Sensor Circuit<br>2. Sensor<br>3. Mixture Too Rich<br>4. Mixture Too Lean<br>5. Three-way Catalytic Converter<br>6. ECM |
| P2270<br>P2271 | 1. Post-Catalytic oxygen sensor voltage is continuously low.<br>2. Post-Catalytic oxygen sensor voltage is continuously high. | 1. Post-Catalytic oxygen sensor voltage is less than 0.6 V.<br>2. Post-Catalytic oxygen sensor voltage is greater than 0.6 V.<br>3. Post-Catalytic oxygen sensor reaches the normal working temperature. | |

3. Schematic




4. Diagnostic Steps:

| | |
|---|---|
| Step 1 | Connect scan tool. |

Next

| | |
|---|---|
| Step 2 | Start engine and turn on the scan tool. |

Next

| | |
|---|---|
| Step 3 | Maintain the engine speed at 2,500 rpm for more than 2 min to warm up the engine, until the engine coolant temperature reaches 80°C (176 ºF). |

Next

| | |
|---|---|
| Step 4 | Select on scan tool: Engine/Read data flow/Group 1 Oxygen sensor voltage 2 (Post-Catalytic oxygen sensors). |

Next

| | |
|---|---|
| Step 5 | Observe oxygen sensor output voltage, the data should be within 0.6-0.7V unchanged. |

Yes

Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

No

| | |
|---|---|
| Step 6 | Test the oxygen sensor signal. |

(a) If the voltage data is consistently below 0.45 V (mixture too lean), carry out steps as following:
- Spray proper amount of propane gas into the intake.
- Check whether the Post-Catalytic oxygen sensor voltage data has a significant change, as it will cause signal voltage rise rapidly.

(b) If the voltage data is consistently above 0.45 V (mixture too rich), carry out steps as following:
- Put gear into Neutral.
- Apply hand brake.
- Press the accelerator pedal so that the engine speed suddenly increases to 4,000 rpm and then quickly release the accelerator pedal.
- Repeat the previous step more than 3 times.
- Check whether the Post-Catalytic oxygen sensor voltage data has a significant change, as it will cause signal voltage decrease rapidly.

During the test, the oxygen sensor signal voltage should have significant changes.

Does voltage have a significant change?

Yes

Check the cause for engine Air-Fuel ratio too lean/too rich. Refer to 2.2.7.4 Fault Symptom Table.

No

| | |
|---|---|
| Step 7 | Check whether there are other control system DTC codes. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Press the scan tool power button.
(d) Select the following menu items: Engine/Read DTC codes.
(e) Read DTC codes.

Results:

| DTC Codes Shown | To Step |
|---|---|
| DTC code other than P0136, P0137, P0138, P0140, P2270, P2271DTC, P0136, P0137, P0138, P0140, P2270, P2271 | No |

| DTC Codes Shown | To Step |
|---|---|
| P0136, P0137, P0138, P0140, P2270, P2271DTC, P0136, P0137, P0138, P0140, P2270, P2271 | Yes |

No → Refer to 2.2.7.11 DTC Code Index

Yes

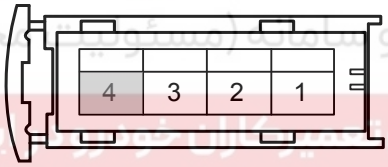
| | |
|---|---|
| Step 8 | Inspect the exhaust system seal. |

(a) Check the three-way catalytic converter appearance (signs of excessive heat, gasket missing, etc.).
(b) Check whether the exhaust pipe is intact and whether gasket is intact.

No → Replace the damaged parts. Go to step 16

| | |
|---|---|
| Step 9 | Measure oxygen sensor signal circuit. |

Post-Catalytic Oxygen Sensor Harness Connector EN03



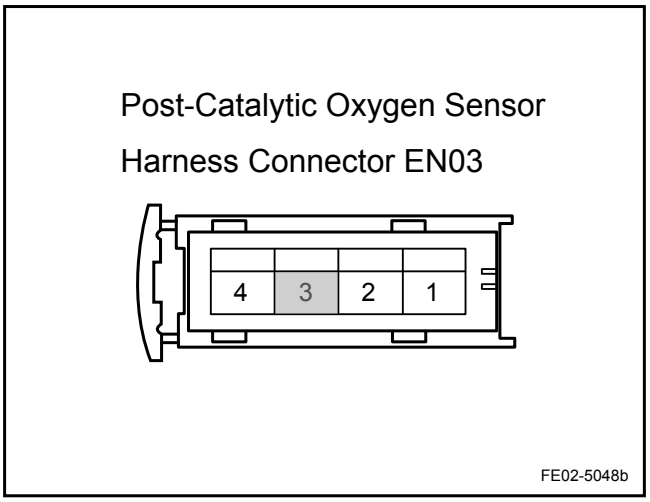

FE02-5047b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the oxygen sensor wiring harness connector EN03.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between oxygen sensor wiring harness connector EN03 terminal No.4 and a reliable ground.
Standard Voltage: 0.35-0.5 V
(e) Connect the oxygen sensor wiring harness connector EN03.
Is voltage the specified value?

No → Go to step 12

Yes

| | |
|---|---|
| Step 10 | Measure the post-catalytic oxygen sensor ground circuit. |




(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the oxygen sensor wiring harness connector EN03.
(c) Turn the ignition switch to "ON" position.
(d) Measure resistance between Post-Catalytic oxygen sensor connector EN03 terminal No.3 and a reliable ground.

Standard Resistance: Less than 1 Ω

(e) Connect the post-catalytic oxygen sensor wiring harness connector EN03.

Is resistance the specified value?

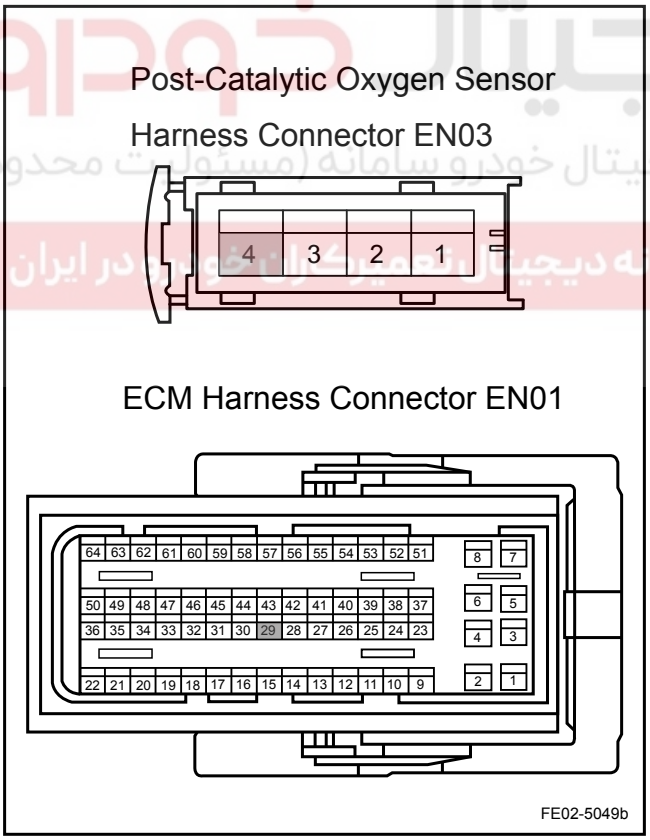
No → Go to step 13

Yes

| Step 11 | Replace the post-catalytic oxygen sensor. |
|---|---|

Next → Go to step 16

| Step 12 | Check the post-catalytic oxygen sensor signal circuit. |
|---|---|



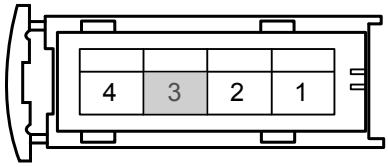

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the post-catalytic oxygen sensor wiring harness connector EN03.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between post-catalytic oxygen sensor wiring harness connector EN03 terminal No.4 and ECM harness connector terminal No.29. Check whether the circuit is open. If there is no open circuit, repair the faulty part.
(e) Measure resistance between post-catalytic oxygen sensor wiring harness connector EN03 terminal No.4 and a reliable ground. Check whether the circuit is short to ground. If there is no short circuit, repair the faulty part.
(f) Measure voltage between post-catalytic oxygen sensor wiring harness connector EN03 terminal No.4 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN03 (4) and EN01 (29) | Less than 1 Ω |
| Resistance Between EN03 (4) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN03 (4) and a Reliable Ground | 0 V |

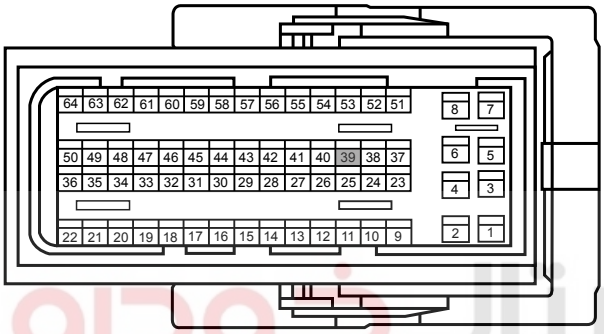
Normal → Go to step 16

| Step 13 | Check oxygen sensor ground circuit. |
|---|---|

Post-Catalytic Oxygen Sensor Harness Connector EN03




ECM Harness Connector EN01

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(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the oxygen sensor wiring harness connector EN03.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between post-catalytic oxygen sensor wiring harness connector EN03 terminal No.3 and ECM harness connector terminal No.39. Check whether the circuit is open. If there is no open circuit, repair the faulty part.
(e) Measure resistance between post-catalytic oxygen sensor wiring harness connector EN03 terminal No.3 and a reliable ground. Check whether the circuit is short to ground. If there is no short circuit, repair the faulty part.
(f) Measure voltage between post-catalytic oxygen sensor wiring harness connector EN03 terminal No.3 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN03 (3) and EN01 (39) | Less than 1 Ω |
| Resistance Between EN03 (3) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN03 (3) and a Reliable Ground | 0 V |

Execute next step as per normal.

Next

| Step 14 | Check ECM power supply circuit. |
|---|---|

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| Step 15 | Replace ECM. |
|---|---|

Next

| Step 16 | Use scan tool to confirm whether the DTC code is stored again. |
|---|---|

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 10 min.

(f) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 17 | Diagnostic completed. |

5. Repair Instructions:

Replace post-catalytic oxygen sensor. Refer to 2.4.7.1 Post-Catalytic Oxygen Sensor Replacement.

## 2.2.7.23 DTC P0170 P0171 P0172 P2177 P2178 P2187 P2188

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0170 | Close-Loop Control Down Stream Air-Fuel Ratio Self Learn Unreasonable |
| DTC | P0171 | Close-Loop Control Down Stream Air-Fuel Ratio Self Learn Too Lean |
| DTC | P0172 | Close-Loop Control Down Stream Air-Fuel Ratio Self Learn Too Rich |
| DTC | P2177 | Close-Loop Control Down Stream Air-Fuel Ratio Self Learn Value Higher Than Maximum |
| DTC | P2178 | Close-Loop Control Down Stream Air-Fuel Ratio Self Learn Value Lower Than Minimum |
| DTC | P2187 | Close-Loop Control Down Stream Air-Fuel Ratio Self Learn Value Higher Than Maximum (Low-Load Zone) |
| DTC | P2188 | Close-Loop Control Down Stream Air-Fuel Ratio Self Learn Value Lower Than Minimum (Low-Load Zone) |

Engine Control Module (ECM) controls the close-loop Air-Fuel ratio Measure system that achieves optimal combination of performance, fuel economy and emissions control. In the close-loop mode, the engine control module monitors heated oxygen sensor ($HO_2S$) signal voltage and adjusts fuel supply according to the signal. Changes in fuel supply will change the value of long-term and short-term fuel supply adjustment. Short-term fuel supply adjustment will respond to heated oxygen sensor signal voltage and rapidly change. These changes will fine tune the fuel supply. Long-term fuel supply adjustment will respond to the trend in short-term fuel supply adjustment. Long-term fuel adjustment adjusts the fuel supply in order to return to the center of the short-term fuel adjustment value and controls the short-term fuel adjustment. The ideal fuel adjustment value is around 0%. A positive value indicates that engine control module is increasing fuel supply to compensate the lean Air-Fuel mixture. A negative value indicates that engine control module is decreasing fuel supply to compensate the rich Air-Fuel mixture.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0170<br>P0171<br>P0172<br>P2177<br>P2178<br>P2187<br>P2188 | 1. Fuel Adjustment Value Higher Than Maximum Limit<br>2. Fuel Adjustment Value Lower Than Minimum Limit<br>3. Fuel Adjustment Value Higher Than Maximum Limit (Low-Load Zone)<br>4. Fuel Adjustment Value Lower Than Minimum Limit (Low-Load Zone) | 1. Excessive air coefficient is higher than the standard value 1.23.<br>2. Excessive air coefficient is higher than the standard value 0.77.<br>3. With engine speed at 1,640-3,200 rpm, throttle opens 20% -60%.<br>4. With engine speed at 1,640-3,200 rpm, throttle opens 20% -60%. | 1. Fuel Injectors<br>2. Canister<br>3. MAP<br>4. TPS<br>5. Pre-Catalytic Oxygen Sensor |

3. Schematic:

Refer to 2.2.6.1 Schematic.

4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Check there are no other control system DTC codes. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Press the scan tool power button.
(d) Select the following menu items: Engine/Read DTC codes.
(e) Read DTC codes.

Are there DTC codes other than P0170, P0171, P0172, P2177, P2178, P2187, P2188?

Yes → Refer to 2.2.7.11 DTC Code Index

No

| | |
|---|---|
| Step 2 | Read the intake manifold absolute pressure sensor data. |

(a) Turn the ignition switch to "OFF" position and connect scan tool.
(b) Start the vehicle.
(c) Read the intake manifold absolute pressure sensor data.
(d) Read the scan tool for atmospheric pressure value, and compare it with table 2.2.1.3 Altitude and Atmospheric Pressure Correlation.

Is scan tool atmospheric pressure reading normal?

No → Refer to 2.2.7.17 DTC P0105 P0106 P0107 P0108

Yes

| | |
|---|---|
| Step 3 | Read the throttle position sensor data. |

(a) Start the vehicle.
(b) Warm up the engine with normal idle speed and throttle opening is less than 10%.
(c) Use scan tool to read throttle position sensor data.
Is throttle position sensor data normal?

No → Refer to 2.2.7.20 DTC P0122 P0123

Yes

| | |
|---|---|
| Step 4 | Read the pre-catalytic oxygen sensor data. |

(a) Start the vehicle.
(b) Warm up the engine with normal idle speed.
(c) Read the pre-catalytic oxygen sensor data.
Pre-Catalytic oxygen sensor standard value: 0.2-0.8 V
Is pre-catalytic oxygen sensor data is normal?

No → Refer to 2.2.7.21 DTC P0130 P0131 P0132 P0133 P0134 P2195 P2196

Yes

| | |
|---|---|
| Step 5 | Observe the long-term fuel adjustment parameter. |

(a) Start the vehicle.
(b) Warm up the engine.
(c) Observe the long-term fuel adjustment parameter.
Is the long-term fuel adjustment parameter normal?

Yes → System normal.

No

| | |
|---|---|
| Step 6 | Check engine and its components. |

(a) Turn the ignition switch to "OFF" position.
(b) Check the vacuum hose crack, kink or connections.
(c) Check the intake manifold, throttle body and fuel injector vacuum leakage.
(d) Check the crankshaft ventilation system leakage.
(e) Check fuel contamination.
(f) Check the fuel system working at air-fuel ratio too lean.
(g) Check injector nozzle spray fuel too lean.
(h) Check the fuel system working at air-fuel ratio too rich.
(i) Check injector spray fuel too rich.
(j) Check intake manifold collapse or obstruction.

(k) Check whether there is excessive fuel in the crankcase.
(l) Check evaporative emission control systems working condition.
(m) Check other fault lights in I/P working condition.
Is engine System normal?

| | |
|---|---|
| Yes | System normal |

No

| | |
|---|---|
| Step 7 | Repair engine and its components. |

Next

| | |
|---|---|
| Step 8 | System normal. |

5. Repair Instructions:

Replace fuel injectors. Refer to 2.2.8.2 Fuel Injector Replacement.

Replace Canister solenoid valve. Refer to 2.4.7.3 Canister Solenoid Valve Replacement.

## 2.2.7.24 DTC P0201 P0261 P0262

1. DTC Descriptor:

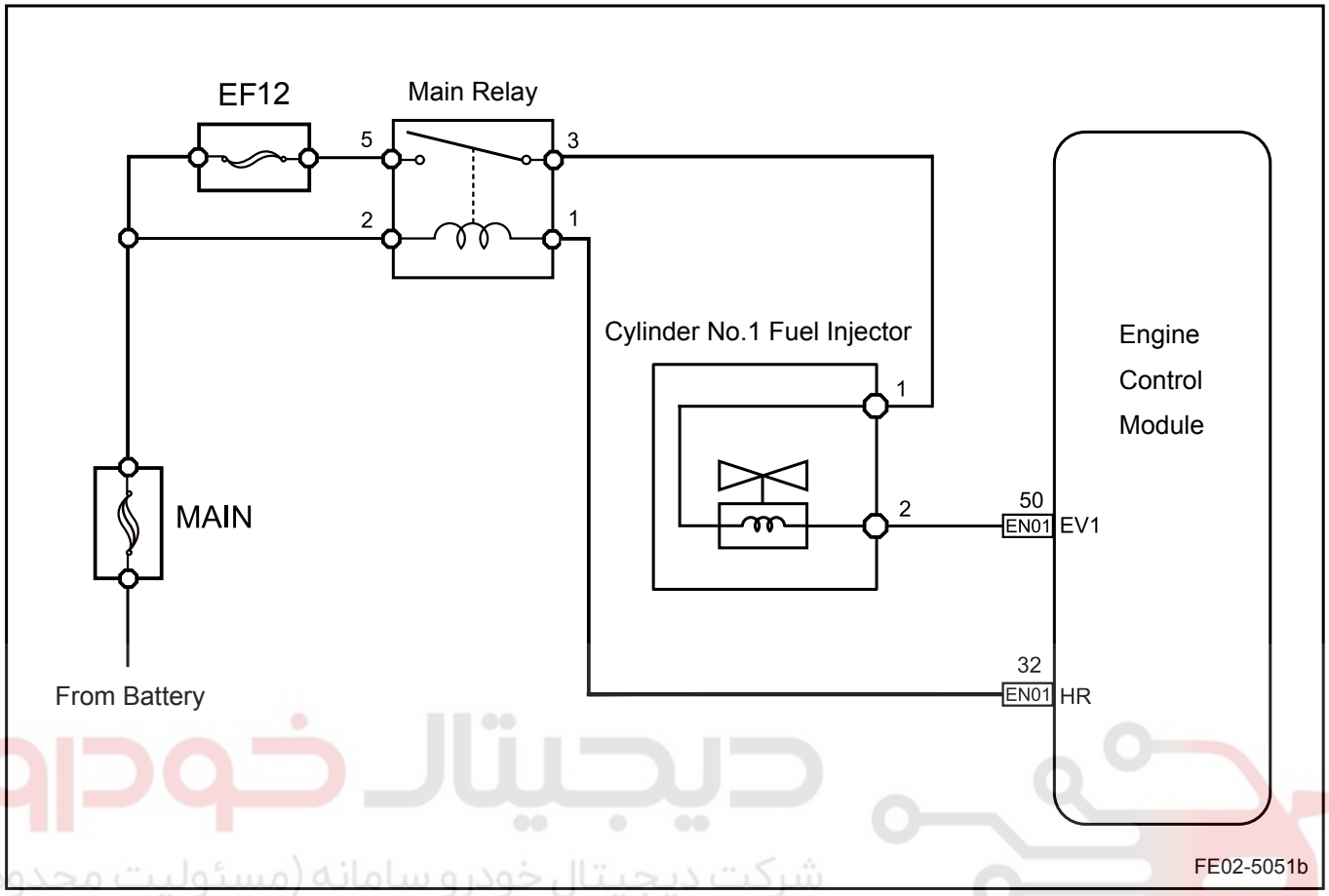
| | | |
|---|---|---|
| DTC | P0201 | Cylinder No.1 Fuel Injection Control Circuit Open |
| DTC | P0261 | Cylinder No.1 Fuel Injector Control Circuit Short to Ground |
| DTC | P0262 | Cylinder No.1 Fuel Injector Control Circuit Short to Power Supply |

Fuel injector operating voltage is provided by The Main Relay which is controlled by ECM. Battery voltage passes through the main relay terminal No.3 to all fuel injector wiring harness connectors terminal No.1. ECM controls fuel injector ground circuit by ECM harness connector EN01 terminal No.50. ECM monitors all fuel injector driver circuit status, if ECM detects driving circuit corresponding voltage is incorrect, ECM will set up a fuel injector control circuit fault DTC code.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0201<br>P0261<br>P0262 | Hardware Circuit Checks | 1. Circuit Open.<br>2. Circuit Short to Ground.<br>3. Circuit Short to Power Supply. | 1. Sensor Circuit<br>2. Sensor<br>3. ECM |

3. Schematic:




4. Diagnostic Steps:

Note

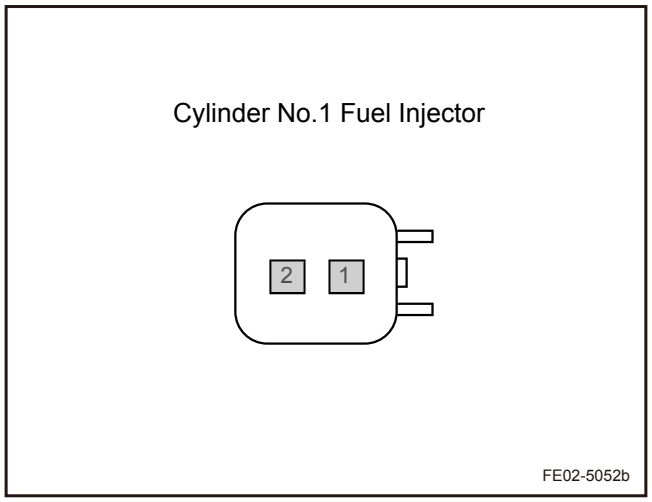
Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Initial Inspection |

(a) Check the fuel injector wiring harness connector for damage, poor connection, aging or signs of loosening.

Next

| | |
|---|---|
| Step 2 | Measure the resistance of fuel injector assembly. |

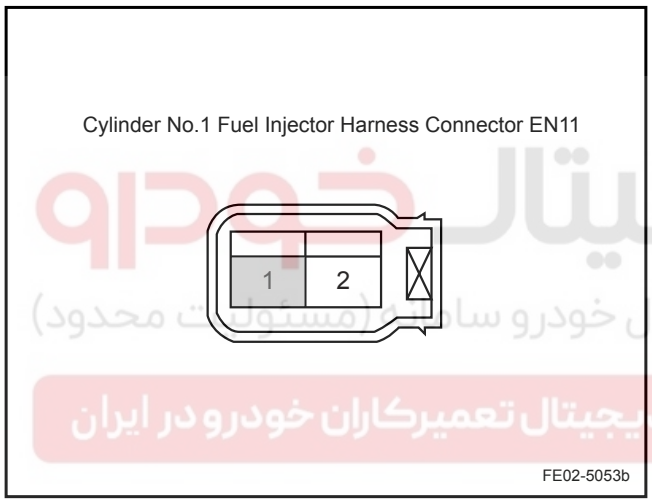



(a) Disconnect the fuel injector wiring harness connector EN11.
(b) Measure resistance between the two fuel injector terminals.
Standard Resistance: 20°C (68 ºF) 11.5-12.5 Ω
(c) Connect the fuel injector wiring harness connector EN11.

No → Replace fuel injector assembly. Refer to 2.2.8.2 Fuel Injector Replacement

Yes

| Step 3 | Measure fuel injectors working power supply. |
|---|---|

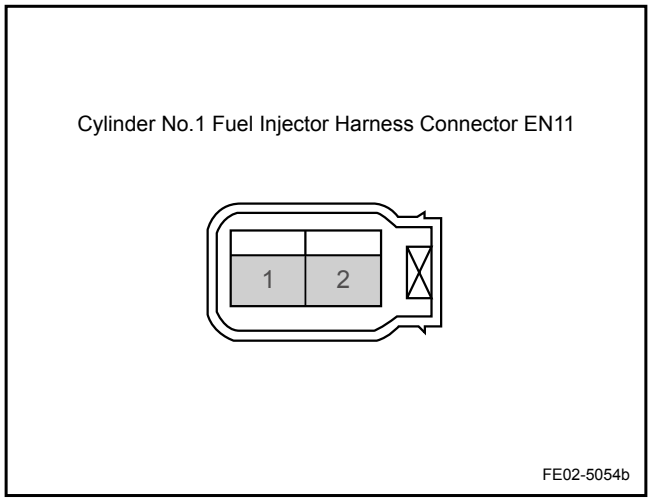



(a) Turn the ignition switch to "OFF" position.
(b) Disconnect cylinder No.1 fuel injector wiring harness connector EN11.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between cylinder No.1 fuel injector wiring harness connector EN11 No.1 terminal and a reliable ground.
Standard Voltage :11-14 V
(e) Connect cylinder No.1 fuel injector wiring harness connector EN11.
Is voltage normal?

No → Go to step 5

Yes

| Step 4 | Check the fuel injector control circuit. |
|---|---|



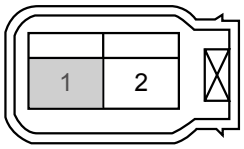

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect cylinder No.1 fuel injector wiring harness connector EN11.
(c) Connect test lamp made from light-emitting diodes to the fuel injector wiring harness connector EN11 terminal No.1 and No.2.
(d) Start the engine.
(e) Check whether the test lamp is flashing as per normal.
Is test lamp flashing as per normal?

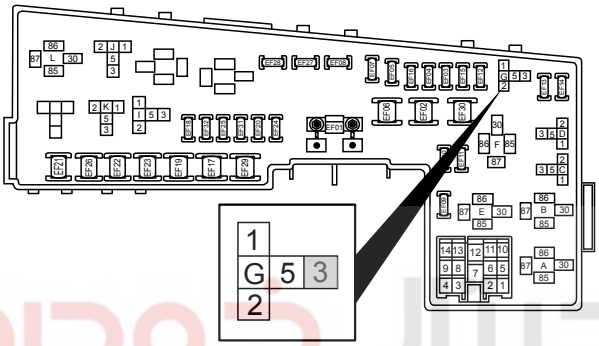
No → Go to step 6

Yes → Go to step 7

| Step 5 | Check and repair cylinder No.1 fuel injector power supply circuit. |
|---|---|

Cylinder No.1 Fuel Injector Harness Connector EN11

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(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the fuel injector wiring harness connector EN11.
(c) Remove the engine main relay.
(d) Measure resistance between cylinder No.1 fuel injector wiring harness connector EN11 terminal No.1 and engine main relay terminal No.3.
(e) Measure resistance between cylinder No.1 fuel injector wiring harness connector EN11 terminal No.1 and a reliable ground.

| Test Items | Standard Value |
|---|---|
| EN11 (1) and Main Relay Terminal No.3 | Less than 1 Ω |
| EN11 (1) and a Reliable Ground | 10 kΩ or higher |

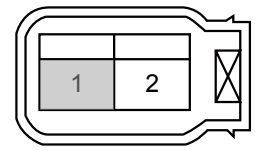
(f) Install the engine main relay.
(g) Connect cylinder No.1 fuel injector wiring harness connector EN11.

Exclude the fuel injector power supply circuit fault.

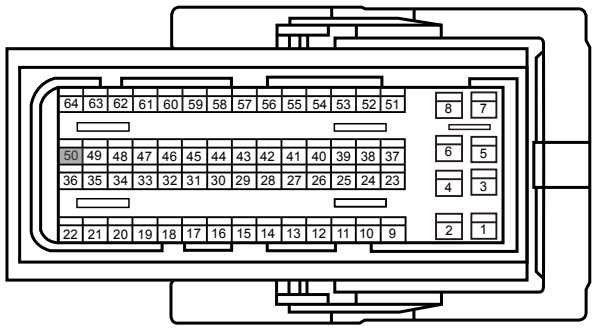
Next → Go to step 9

| Step 6 | Check cylinder No.1 fuel injector control circuit. |
|---|---|

Cylinder No.1 Fuel Injector Harness Connector EN11




ECM Harness Connector EN01

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(a) Turn the ignition switch to "OFF" position.
(b) Disconnect cylinder No.1 fuel injector wiring harness connector EN11.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between cylinder No.1 fuel injector wiring harness connector EN11 terminal No.1 and ECM harness connector terminal No.50. Check whether the circuit is open. If there is no open circuit, repair the faulty part.
(e) Measure resistance between cylinder No.1 fuel injector wiring harness connector EN11 terminal No.1 and a reliable ground. Check whether the circuit is short to ground. If there is no short circuit, repair the faulty part.
(f) Measure voltage between cylinder No.1 fuel injector wiring harness connector EN11 terminal No.1 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN11 (1) and EN01 (50) | Less than 1 Ω |
| Resistance Between EN11 (1) and a Reliable Ground | 10 kΩ or higher |

| | |
|---|---|
| Voltage Between EN11 (1) and a Reliable Ground | 0 V |

Execute next step as per normal.

Next

| | |
|---|---|
| Step 7 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 8 | Replace ECM. |

Next

| | |
|---|---|
| Step 9 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 10 min.
(f) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 10 | Diagnostic completed. |

5. Repair Instructions:

Replace the fuel injector. Refer to 2.2.8.2 Fuel Injector Replacement.

## 2.2.7.25 DTC P0202 P0264 P0265

1. DTC Descriptor:

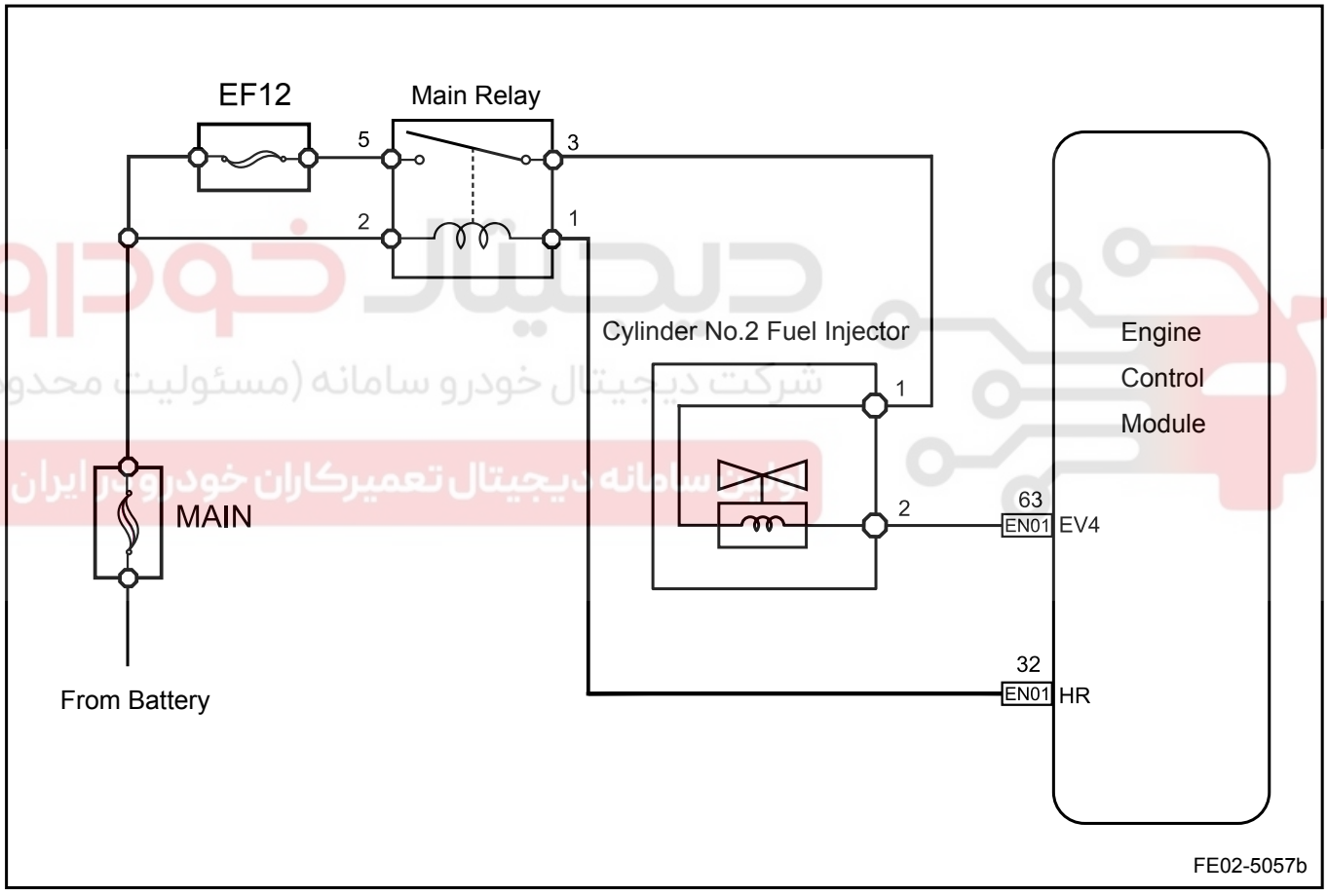
| | | |
|---|---|---|
| DTC | P0202 | Cylinder No.2 Fuel Injector Control Circuit Open |
| DTC | P0264 | Cylinder No.2 Fuel Injector Control Circuit Short to Ground |
| DTC | P0265 | Cylinder No.2 Fuel Injector Control Circuit Short to Power Supply |

Fuel injector operating voltage is provided by The Main Relay which is controlled by ECM. Battery voltage passes through the main relay terminal No.3 to all fuel injector wiring harness connectors terminal No.1. ECM controls fuel injector ground circuit by ECM harness connector EN01 terminal No.63. ECM monitors all fuel injector driver circuit status, if ECM detects driving circuit corresponding voltage is incorrect, ECM will set up a fuel injector control circuit fault DTC code.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0202<br>P0264<br>P0265 | Hardware Circuit Checks | 1. Circuit Open.<br>2. Circuit Short to Ground.<br>3. Circuit Short to Power Supply. | 1. Sensor Circuit<br>2. Sensor<br>3. ECM |

3. Schematic:




4. Diagnostic Steps:

Note

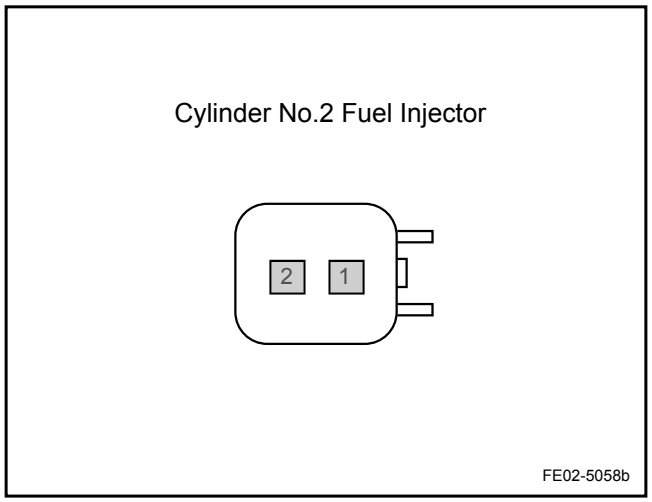
Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Initial Inspection |

(a) Check the fuel injector wiring harness connector for damage, poor connection, aging or signs of loosening.

Next

| | |
|---|---|
| Step 2 | Measure the resistance of fuel injector assembly. |

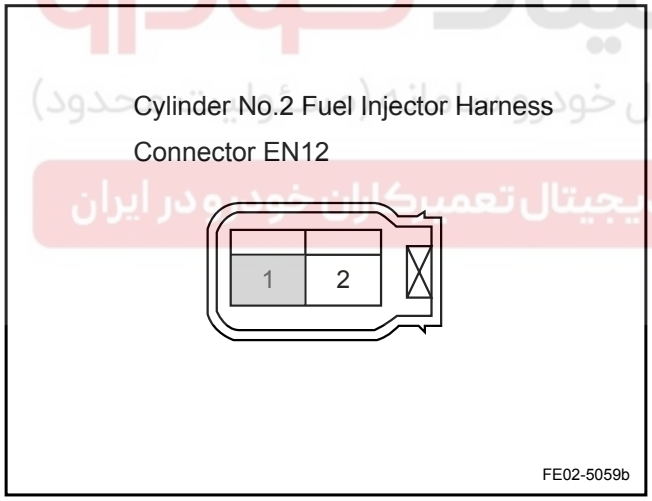



(a) Disconnect the fuel injector wiring harness connector EN12.
(b) Measure resistance between the two fuel injector terminals.
Standard Resistance: 20°C (68 ºF) 11.5-12.5 Ω
(c) Connect the fuel injector wiring harness connector EN12.

No → Replace fuel injector assembly. Refer to 2.2.8.2 Fuel Injector Replacement

Yes

| | |
|---|---|
| Step 3 | Measure fuel injectors working power supply. |



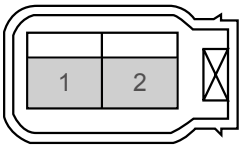

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect cylinder No.1 fuel injector wiring harness connector EN12.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between cylinder No.2 fuel injector wiring harness connector EN12 No.1 terminal and a reliable ground.
Standard Voltage: 11-14 V
(e) Connect cylinder No.2 fuel injector wiring harness connector EN12.
Is voltage normal?

No → Go to step 5

Yes

| | |
|---|---|
| Step 4 | Check the fuel injector control circuit. |

Cylinder No.2 Fuel Injector Harness Connector EN12

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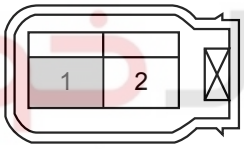
(a) Turn the ignition switch to "OFF" position.
(b) Disconnect cylinder No.1 fuel injector wiring harness connector EN12.
(c) Connect test lamp made from light-emitting diodes to the fuel injector wiring harness connector EN12 terminal No.1 and No.2.
(d) Start the engine.
(e) Check whether the test lamp is flashing as per normal.

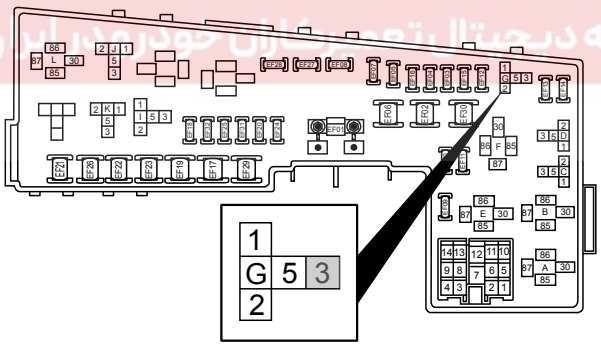
Is test lamp flashing as per normal?

| | |
|---|---|
| No | Go to step 6 |
| Yes | Go to step 7 |

| | |
|---|---|
| Step 5 | Check and repair cylinder No.2 fuel injector power supply circuit. |

Cylinder No.2 Fuel Injector Harness Connector EN12

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(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the fuel injector wiring harness connector EN12.
(c) Remove the engine main relay.
(d) Measure resistance between cylinder No.2 fuel injector wiring harness connector EN12 terminal No.1 and engine main relay terminal No.3.
(e) Measure resistance between cylinder No.2 fuel injector wiring harness connector EN12 terminal No.1 and a reliable ground.

| Test Items | Standard Value |
|---|---|
| EN12 (1) and Main Relay Terminal No.3 | Less than 1 Ω |
| EN12 (1) and a Reliable Ground | 10 kΩ or higher |

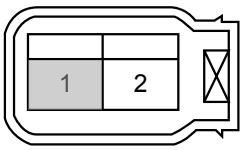
(f) Install the engine main relay.
(g) Connect cylinder No.2 fuel injector wiring harness connector EN12.

Exclude the fuel injector power supply circuit fault.

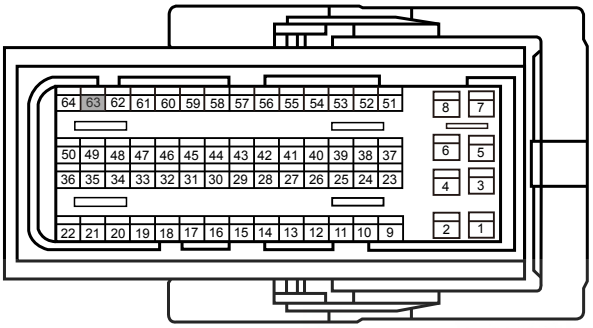
| | |
|---|---|
| Next | Go to step 9 |

| | |
|---|---|
| Step 6 | Check cylinder No.2 fuel injector control circuit. |

Cylinder No.2 Fuel Injector Harness Connector EN12




ECM Harness Connector EN01




FE02-5062b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect cylinder No.2 fuel injector wiring harness connector EN12.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between cylinder No.2 fuel injector wiring harness connector EN12 terminal No.1 and ECM harness connector terminal No.63. Check whether the circuit is open. If there is no open circuit, repair the faulty part.
(e) Measure resistance between cylinder No.2 fuel injector wiring harness connector EN12 terminal No.1 and a reliable ground. Check whether the circuit is short to ground. If there is no short circuit, repair the faulty part.
(f) Measure voltage between cylinder No.2 fuel injector wiring harness connector EN12 terminal No.1 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN12 (1) and EN01 (63) | Less than 1 Ω |
| Resistance Between EN12 (1) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN12 (1) and a Reliable Ground | 0 V |

Execute next step as per normal.

Next

| | |
|---|---|
| Step 7 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 8 | Replace ECM. |

Next

| | |
|---|---|
| Step 9 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 10 min.
(f) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 10 | Diagnostic completed. |

5. Repair Instructions:

Replace the fuel injector. Refer to 2.2.8.2 Fuel Injector Replacement.

## 2.2.7.26 DTC P0203 P0267 P0268

1. DTC Descriptor:

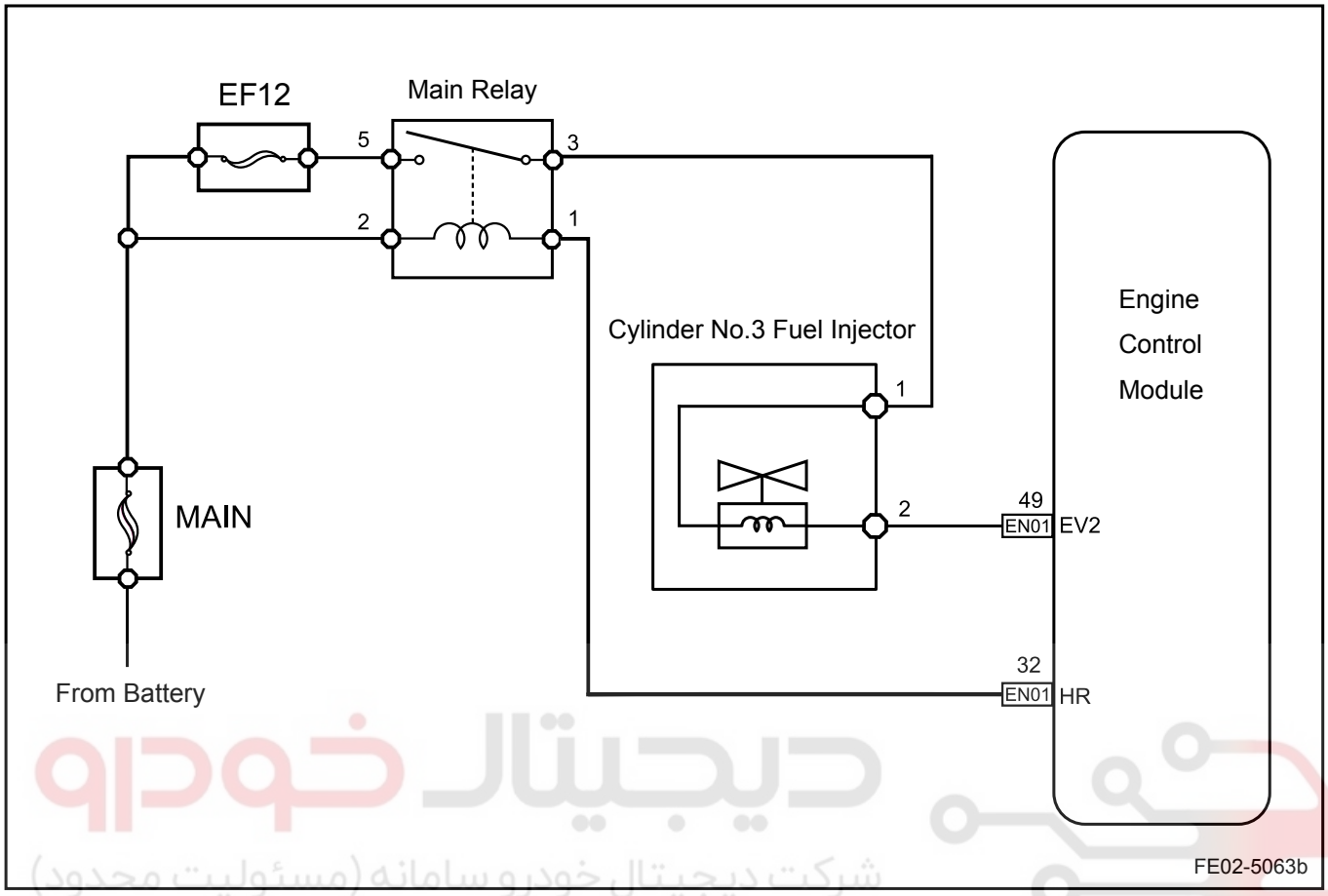
| | | |
|---|---|---|
| DTC | P0203 | Cylinder No.3 Fuel Injection Control Circuit Open |
| DTC | P0267 | Cylinder No.3 Fuel Injector Control Circuit Short to Ground |
| DTC | P0268 | Cylinder No.3 Fuel Injector Control Circuit Short to Power Supply |

Fuel injector operating voltage is provided by the main relay which is controlled by ECM. Battery voltage passes through the main relay terminal No.3 to all fuel injector wiring harness connectors terminal No.1. ECM controls fuel injector ground circuit by ECM harness connector EN01 terminal No.49. ECM monitors all fuel injector driver circuit status, if ECM detects driving circuit corresponding voltage is incorrect, ECM will set up a fuel injector control circuit fault DTC code.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0203<br>P0267<br>P0268 | Hardware Circuit Checks | 1. Circuit Open.<br>2. Circuit Short to Ground.<br>3. Circuit Short to Power Supply. | 1. Sensor Circuit<br>2. Sensor<br>3. ECM |

3. Schematic




4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

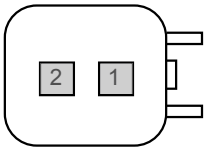
| | |
|---|---|
| Step 1 | Initial Inspection |

(a) Check the fuel injector wiring harness connector for damage, poor connection, aging or signs of loosening.

Next

| | |
|---|---|
| Step 2 | Measure the resistance of fuel injector assembly. |

Cylinder No.3 Fuel Injector




FE02-5064b

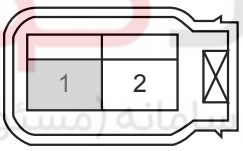
(a) Disconnect the fuel injector wiring harness connector EN13.
(b) Measure resistance between the two fuel injector terminals.
Standard Resistance: 20°C (68 ºF) 11.5-12.5 Ω
(c) Connect the fuel injector wiring harness connector EN13.

No → Replace fuel injector assembly. Refer to 2.2.8.2 Fuel Injector Replacement

Yes

| Step 3 | Measure fuel injectors working power supply. |
|---|---|

Cylinder No.3 Fuel Injector Harness Connector EN13




FE02-5065b

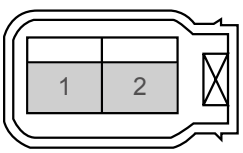
(a) Turn the ignition switch to "OFF" position.
(b) Disconnect cylinder No.3 fuel injector wiring harness connector EN13.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between cylinder No.3 fuel injector wiring harness connector EN13 No.1 terminal and a reliable ground.
Standard Voltage: 11-14 V
(e) Connect cylinder No.3 fuel injector wiring harness connector EN13.
Voltage normal?

No → Go to step 5

Yes

| Step 4 | Check the fuel injector control circuit. |
|---|---|

Cylinder No.3 Fuel Injector Harness Connector EN13




FE02-5066b

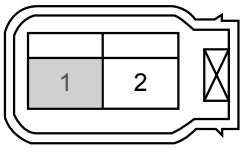
(a) Turn the ignition switch to "OFF" position.
(b) Disconnect cylinder No.3 fuel injector wiring harness connector EN13.
(c) Connect test lamp made from light-emitting diodes to the fuel injector wiring harness connector EN13 terminal No.1 and No.2.
(d) Start the engine.
(e) Check whether the test lamp is flashing as per normal.
Is test lamp flashing as per normal?

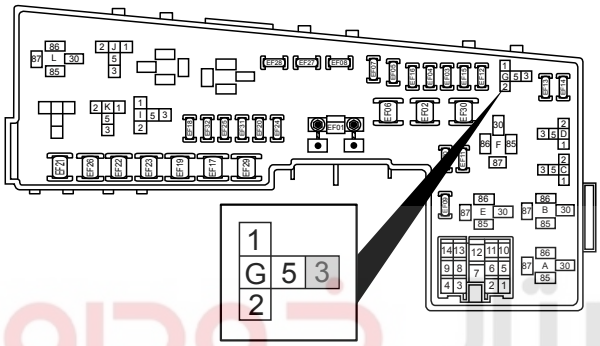
No → Go to step 6

Yes → Go to step 7

| Step 5 | Check and repair cylinder No.3 fuel injector power supply circuit. |
|---|---|

Cylinder No.3 Fuel Injector Harness Connector EN13




FE02-5067b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the fuel injector wiring harness connector EN13.
(c) Remove the engine main relay.
(d) Measure resistance between cylinder No.3 fuel injector wiring harness connector EN13 terminal No.1 and engine main relay terminal No.3.
(e) Measure resistance between cylinder No.3 fuel injector wiring harness connector EN13 terminal No.1 and a reliable ground.

| Test Items | Standard Value |
|---|---|
| EN13 (1) and Main Relay Terminal No.3 | Less than 1 Ω |
| EN13 (1) and a Reliable Ground | 10 kΩ or higher |

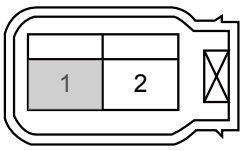
(f) Install the engine main relay.
(g) Connect cylinder No.3 fuel injector wiring harness connector EN13.

Exclude the fuel injector power supply circuit fault.

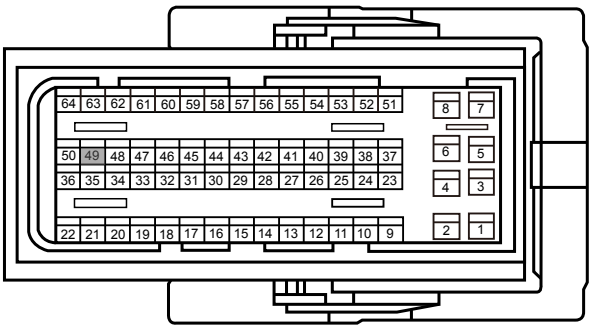
Next → Go to step 9

| Step 6 | Check 3-cylinder fuel injector control circuit. |
|---|---|

Cylinder No.3 Fuel Injector Harness Connector EN13




ECM Harness Connector EN01




FE02-5068b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect cylinder No.3 fuel injector wiring harness connector EN13.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between cylinder No.3 fuel injector wiring harness connector EN13 terminal No.1 and ECM harness connector terminal No.49. Check whether the circuit is open. If there is no open circuit, repair the faulty part.
(e) Measure resistance between cylinder No.3 fuel injector wiring harness connector EN13 terminal No.1 and a reliable ground. Check whether the circuit is short to ground. If there is no short circuit, repair the faulty part.
(f) Measure voltage between cylinder No.3 fuel injector wiring harness connector EN13 terminal No.1 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN13 (1) and EN01 (49) | Less than 1 Ω |
| Resistance Between EN13 (1) and a Reliable Ground | 10 kΩ or higher |

| | |
|---|---|
| Voltage Between EN13 (1) and a Reliable Ground | 0 V |

Execute next step as per normal.

Next

| | |
|---|---|
| Step 7 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 8 | Replace ECM. |

Next

| | |
|---|---|
| Step 9 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 10 min.
(f) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 10 | Diagnostic completed. |

5. Repair Instructions:

Replace the fuel injector. Refer to 2.2.8.2 Fuel Injector Replacement.

## 2.2.7.27 DTC P0204 P0270 P0271

1. DTC Descriptor:

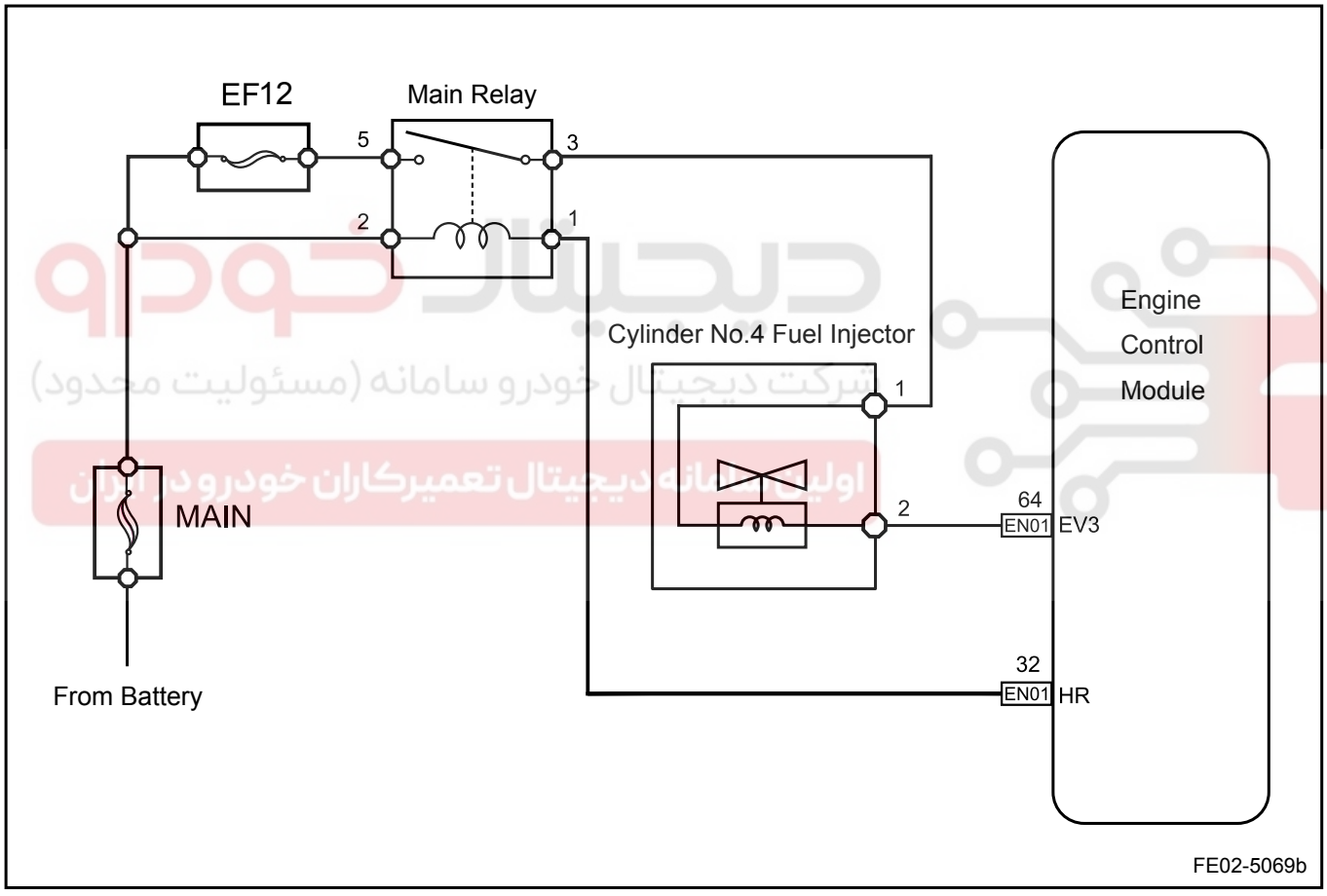
| | | |
|---|---|---|
| DTC | P0204 | Cylinder No.4 Fuel Injection Control Circuit Open |
| DTC | P0270 | Cylinder No.4 Fuel Injector Control Circuit Short to Ground |
| DTC | P0271 | Cylinder No.4 Fuel Injector Control Circuit Short to Power Supply |

Fuel injector operating voltage is provided by The Main Relay which is controlled by ECM. Battery voltage passes through the main relay terminal No.3 to all fuel injector wiring harness connectors terminal No.1. ECM controls fuel injector ground circuit by ECM harness connector EN01 terminal No.64. ECM monitors all fuel injector driver circuit status, if ECM detects driving circuit corresponding voltage is incorrect, ECM will set up a fuel injector control circuit fault DTC code.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0204<br>P0270<br>P0271 | Hardware Circuit Checks | 1. Circuit Open.<br>2. Circuit Short to Ground.<br>3. Circuit Short to Power Supply. | 1. Sensor Circuit<br>2. Sensor<br>3. ECM |

3. Schematic:




4. Diagnostic Steps:

Note

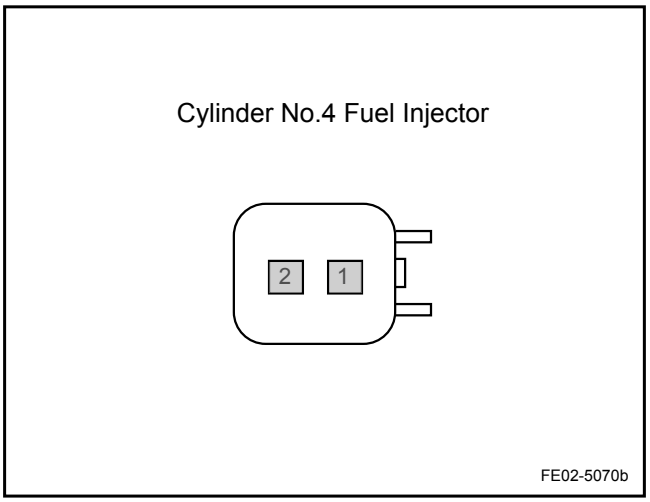
Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Initial Inspection |

(a) Check the fuel injector wiring harness connector for damage, poor connection, aging or signs of loosening.

Next

| | |
|---|---|
| Step 2 | Measure the resistance of fuel injector assembly. |

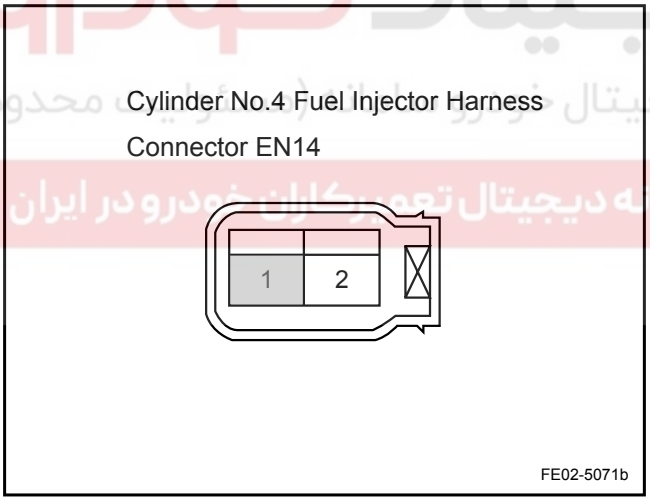



(a) Disconnect the fuel injector wiring harness connector EN14.
(b) Measure resistance between the two fuel injector terminals.
Standard Resistance: 20°C (68 °F) 11.5-12.5 Ω
(c) Connect the fuel injector wiring harness connector EN14.

No → Replace fuel injector assembly. Refer to 2.2.8.2 Fuel Injector Replacement

Yes

| | |
|---|---|
| Step 3 | Measure fuel injectors working power supply. |



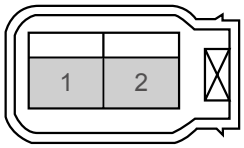

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect cylinder No.4 fuel injector wiring harness connector EN14.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between cylinder No.4 fuel injector wiring harness connector EN14 No.1 terminal and a reliable ground.
Standard Voltage: 11-14 V
(e) Connect cylinder No.4 fuel injector wiring harness connector EN14.
Is voltage normal?

No → Go to step 5

Yes

| | |
|---|---|
| Step 4 | Check the fuel injector control circuit. |

Cylinder No.4 Fuel Injector Harness Connector EN14




FE02-5072b

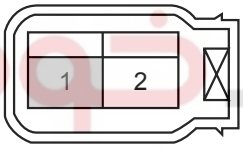
(a) Turn the ignition switch to "OFF" position.
(b) Disconnect cylinder No.1 fuel injector wiring harness connector EN14.
(c) Connect test lamp made from light-emitting diodes to the fuel injector wiring harness connector EN14 terminal No.1 and No.2.
(d) Start the engine.
(e) Check whether the test lamp is flashing as per normal.

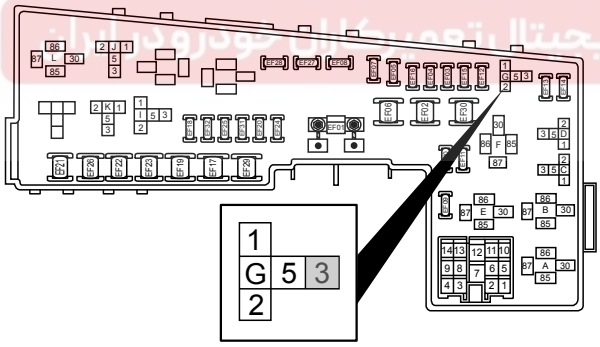
Is test lamp flashing as per normal?

| | |
|---|---|
| No | Go to step 6 |
| Yes | Go to step 7 |

| | |
|---|---|
| Step 5 | Check and repair cylinder No.4 fuel injector power supply circuit. |

Cylinder No.4 Fuel Injector Harness Connector EN14




FE02-5073b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the fuel injector wiring harness connector EN14.
(c) Remove the engine main relay.
(d) Measure resistance between cylinder No.4 fuel injector wiring harness connector EN14 terminal No.1 and engine main relay terminal No.3.
(e) Measure resistance between cylinder No.4 fuel injector wiring harness connector EN14 terminal No.1 and a reliable ground

| Test Items | Standard Value |
|---|---|
| EN14 (1) and Main Relay Terminal No.3 | Less than 1 Ω |
| EN14 (1) and a Reliable Ground | 10 kΩ or higher |

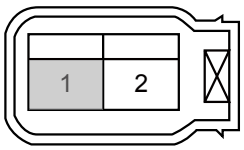
(f) Install the engine main relay.
(g) Connect cylinder No.4 fuel injector wiring harness connector EN14.

Exclude the fuel injector power supply circuit fault.

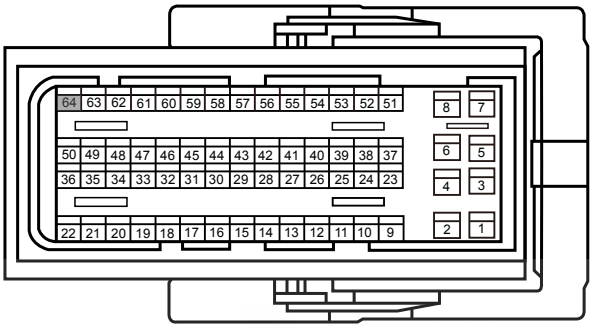
| | |
|---|---|
| Next | Go to step 9 |

| | |
|---|---|
| Step 6 | Check cylinder No.4 fuel injector control circuit. |

Cylinder No.4 Fuel Injector Harness Connector EN14




ECM Harness Connector EN01




FE02-5074b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect cylinder No.4 fuel injector wiring harness connector EN14.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between cylinder No.4 fuel injector wiring harness connector EN14 terminal No.1 and ECM harness connector terminal No.64. Check whether the circuit is open. If there is no open circuit, repair the faulty part.
(e) Measure resistance between cylinder No.4 fuel injector wiring harness connector EN14 terminal No.1 and a reliable ground. Check whether the circuit is short to ground. If there is no short circuit, repair the faulty part.
(f) Measure voltage between cylinder No.4 fuel injector wiring harness connector EN14 terminal No.1 and a reliable ground. Check whether the circuit is short to power supply. If there is no short circuit, repair the faulty part.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN14 (1) and EN01 (64) | Less than 1 Ω |
| Resistance Between EN14 (1) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN14 (1) and a Reliable Ground | 0 V |

Execute next step as per normal.

Next

| | |
|---|---|
| Step 7 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 8 | Replace ECM. |

Next

| | |
|---|---|
| Step 9 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 10 min.
(f) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 10 | Diagnostic completed. |

5. Repair Instructions:

Replace the fuel injector. Refer to 2.2.8.2 Fuel Injector Replacement.

## 2.2.7.28 DTC P0300-P0304

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0300 | Multi-Cylinder Misfire |
| DTC | P0301 | Cylinder No.1 Misfire |
| DTC | P0302 | Cylinder No.2 Misfire |
| DTC | P0303 | Cylinder No.3 Misfire |
| DTC | P0304 | Cylinder No.4 Misfire |

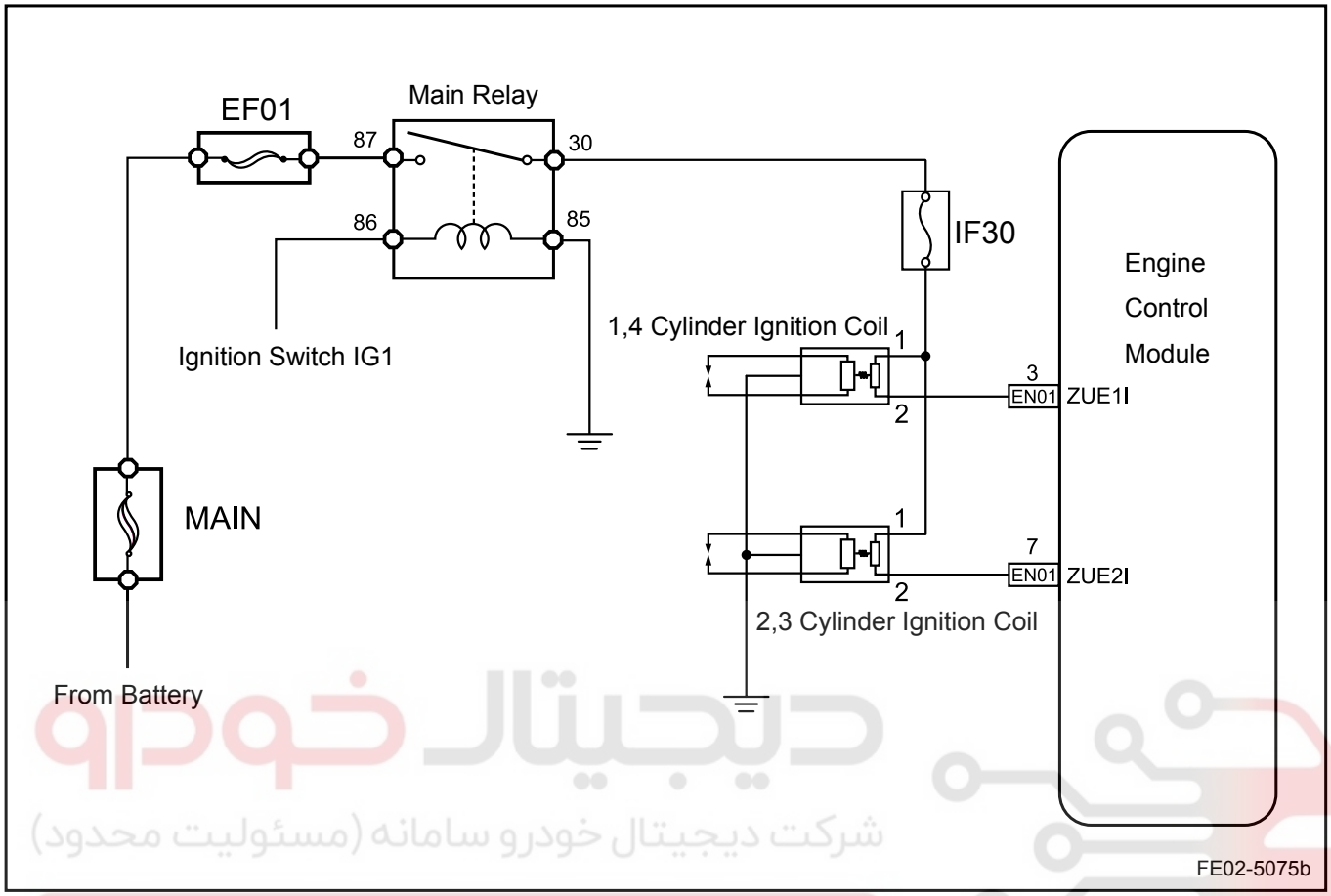
The engine control module (ECM) uses information from the crankshaft position (CKP) sensor and the camshaft position (CMP) sensors to determine when an engine misfire is occurring. By monitoring variations in the crankshaft rotation speed for each cylinder ECM is able to detect individual misfire events. When a misfire happens, unburnt mixture will be discharged into the exhaust system and burnt in the exhaust system. A misfire rate that is high enough can cause 3-way catalytic converter damage. The malfunction indicator lamp (MIL) will flash ON and OFF when the conditions for catalytic converter damage are present. A DTC will be set.

2. DTC Code Set Up and Removal Conditions:

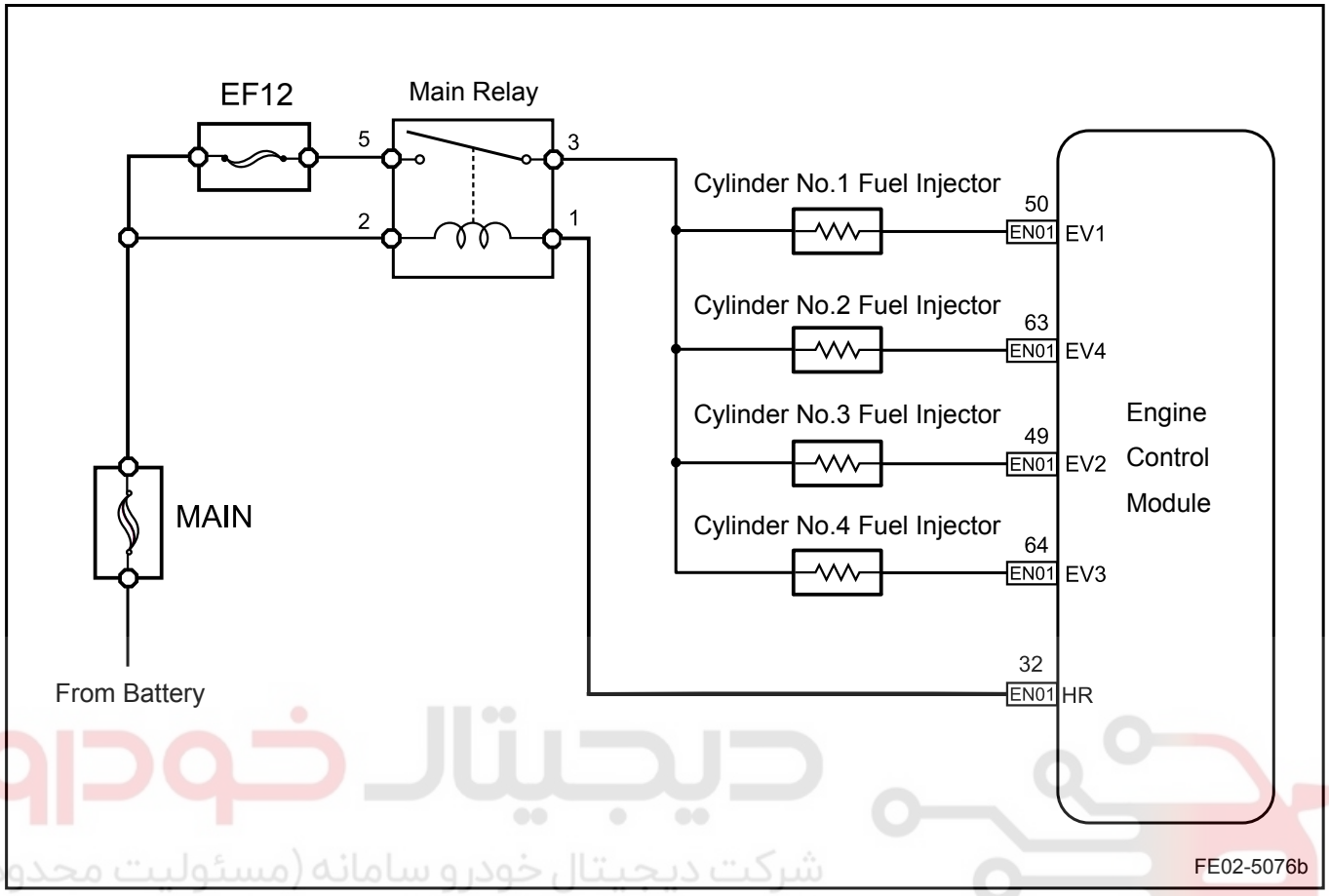
| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0300<br>P0301<br>P0302<br>P0303<br>P0304 | 1. A Misfire Rate Sufficient to Cause Damage to Catalytic Converters<br>2. A Misfire Rate Sufficient to Cause the Emission Deterioration<br>3. Doubtful Error | 1. Each Cylinder Catalytic Converter Damage Related Misfire Counters.<br>2. Catalytic Converter Damage Misfire Rate More Than 4.5% -20%.<br>3. Four Emissions Related All Cylinder Misfire Counts In One Driving Cycle.<br>4. Misfire Rate Causing Emission Deterioration More Than 3.0%.<br>5. After Starting Each Cylinder Emission Related Misfire Counts During a Count Cycle.<br>6. Undetected Bad Circuit.<br>7. Fuel Control Inactivated.<br>8. Torque Intervention Inactivated.<br>9. Engine speed is greater than 600 rpm and less than 5,000 rpm.<br>10. Intake air temperature is greater than -30°C (-22 ºF). | 1. Connector Loose or Poor Connection<br>2. Vacuum Tube Hose Broken or Loose<br>3. Ignition System<br>4. Fuel Injectors<br>5. Fuel Pressure<br>6. Intake Air Pressure Sensor<br>7. Engine Coolant Temperature Sensor<br>8. Cylinder Compression Pressure<br>9. Valve Clearance and Timing<br>10. Evaporative Emission Control System<br>11. Purged Crankcase Ventilation System<br>12. Intake System<br>13. Poor Exhaust System Ventilation<br>14. ECM |

3. Schematic:

Ignition System



Fuel Injector




4. Diagnostic Steps:

Note

- If the control system stores DTC other than misfire, diagnose these DTC first and eliminate the faults.
- If the vehicle does not have a misfire when sent to a service station, road test the vehicle, so that the misfire will occur again. Use scan tool to record ECM data when misfire is occurring, in order to facilitate analyzing the cause of the fault.
- If after a long period road test, ECM does not store any misfire associated DTC codes, then the fault may be due to the following reasons:
  - Overfill fuel tank and fuel enters into the evaporative emission control system, so that the mixture is too rich and causes misfire.
  - Use improper fuel caused poor combustion and misfire.
  - Contaminated spark plug causes the ignition failure and misfire.
  - Carry out basic checks at fault locations identified by DTC codes.
- Road test the vehicle after repair to confirm no DTC is stored.

| | |
|---|---|
| Step 1 | Initial inspection. |

(a) Check the wiring harness connector for damage, poor connection, aging or signs of loosening.

(b) Check the vacuum tube for damaged, loose, leakage and so on.

Next

| Step 2 | Check for other DTC codes. |
|---|---|

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Press the scan tool power button.
(d) Select the following menu items: Engine/Read DTC codes.
(e) Read DTC codes.

Results:

| DTC Codes Shown | To Step |
|---|---|
| DTC Codes Other Than DTC P0300-P0304 | No |
| DTC P0300-P0304 | Yes |

No → Refer to 2.2.7.11 DTC Code Index

Yes

| Step 3 | Check valves and air intake system. |
|---|---|

(a) Check vacuum solenoid valve Canister connection is correct or not and leakage.
(b) Check the vacuum brake booster vacuum tube connection is correct or not and leakage.
(c) Check the intake tube pressure sensor connection is correct or not and leakage.
(d) Check purged crankcase ventilation valve, ventilation pipe connection is correct or not and leakage.
(e) Check whether there is intake leakage.

Is there above mentioned fault?

Yes → Fault location. Go to step 17

No

| Step 4 | Check the Spark Plug. |
|---|---|

(a) Remove the spark plug from the misfire cylinder.
(b) Check whether the spark plug gap is too large or too small.

Standard Gap: 0.8-0.9 mm (0.031-0.035 in)

(c) Check the existence of spark plug electrode erosion, damage.
(d) Check whether the spark plug and the electrode part skirt is wet or not and check the existence of a serious gasoline leakage.
(e) Reinstall the spark plug.

Is there above mentioned fault?

Yes → Replace the spark plug. Refer to 2.10.8.4 Spark Plug Replacement. Go to step 8

No

Note

Prior to the implementation of this program, the following conditions must be met:

1. Disconnect all fuel injector connectors.
2. Engine running time must not be longer than 5 s.

| | |
|---|---|
| Step 5 | Check whether the spark plug arcing is normal. |

(a) Test the spark.
(b) Remove misfire cylinder ignition wires.
(c) Disconnect all fuel injector cylinder connectors.
(d) Install the ignition wires to the spark plug.
(e) Run the engine (the engine running time no longer than 5 s) and check the arcing.
(f) Reconnect all cylinder fuel injector connectors.
(g) Install the ignition wires.

Is spark plug arcing normal?

No → Go to step 9

Yes

| | |
|---|---|
| Step 6 | Check the misfire cylinder compression pressure. |

(a) For detailed steps. Refer to

Is cylinder compression pressure normal?

Yes → Go to step 10

No

| | |
|---|---|
| Step 7 | Check the cause of cylinder compression pressure too low. Refer to the "Engine Mechanical System" in the2.6.7 Diagnostic Information and Procedures. |

| | |
|---|---|
| Step 8 | Check fuel and misfire cylinder fuel injectors. |

(a) Check whether there is fuel injectors leakage and stagnate.
(b) Check fuel quality.

Is there above mentioned fault?

Yes → Repair the faulty part. Go to step 17

No

Note

Prior to the implementation of this test, the following conditions must be met:

1. Disconnect all fuel injector connectors.

2. Run the engine for no longer than 5s.

| Step 9 | Use a properly working spark plug and check whether there is misfire cylinder arcing. |
|---|---|

(a) Replace the installed spark plug with a spark plug that works properly.
(b) Test spark plug.
(c) Remove misfire cylinder ignition wires.
(d) Disconnect all fuel injector cylinder connectors.
(e) Install the ignition wires to the spark plug.
(f) Run the engine (the engine running time no longer than 5 s) and check the arcing.
(g) Reconnect all cylinder fuel injector connectors.
(h) Install the ignition wires.

Is spark plug arcing normal?

| | |
|---|---|
| No | Check the ignition coil and ignition wire. Go to step 17 |
| Yes | Replace the spark plug. Refer to 2.10.8.4 Spark Plug Replacement. Go to step 17 |

| Step 10 | Check ECM connector terminal voltage of the misfire cylinder fuel injector. |
|---|---|

ECM Harness Connector EN01


FE02-5077b

(a) Turn the ignition switch to the "ON" position.
(b) Connect ECM harness EN01.
(c) Measure ECM harness connector EN01 terminal voltage according to the following table.

| Connector Terminal | Standard Value |
|---|---|
| EN01 (49) | 9-14 V |
| EN01 (50) | |
| EN01 (63) | |
| EN01 (64) | |

Is voltage the specified value?

| | |
|---|---|
| No | Check the fuel injector circuit. Refer to 2.2.7.24 DTC P0201 P0261 P0262 |

Yes

| Step 11 | Check the misfire cylinder valve gap. |
|---|---|

(a) Refer to the "Engine Mechanical System" in the2.6.8.20 Valve Clearance Adjustments, Is valve clearance normal?

| | |
|---|---|
| No | Adjust the valve clearance. Go to step 17 |

Yes

| | |
|---|---|
| Step 12 | Check valve timing system. |

(a) Refer to the "Engine Mechanical System" in the2.6.8.9Timing Chain Cover Replacement, Is valve timing normal?

No → Adjust the valve timing. Go to step 17

Yes

| | |
|---|---|
| Step 13 | Check the fuel pressure. |

(a) Refer to "Fuel System" in the2.3.7.7 Fuel Pressure Testing Procedure, Is fuel pressure normal?

No → Check fuel system: fuel pump, fuel filter, fuel pipe circuit and fuel pressure regulator. Go to step 17

Yes

| | |
|---|---|
| Step 14 | Check whether the data in the data stream table is normal. |

(a) Check intake air pressure sensor data.
(b) Check engine coolant temperature sensor data.
(c) Check throttle position sensor.
Are these components normal?

No → Replace the damaged components. Go to step 17

Yes

| | |
|---|---|
| Step 15 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 16 | Replace ECM. |

Next

| | |
|---|---|
| Step 17 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 10 min.
(f) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 18 | Diagnostic completed. |

5. Repair Instructions:

Replace the spark plug. Refer to 2.10.8.4 Spark Plug Replacement.

## 2.2.7.29 DTC P0321 P0322

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0321 | Speed Reference Point Fault |

| | | |
|---|---|---|
| DTC | P0322 | No CKP Sensor Pulse Signal (Open or Short Circuit) |

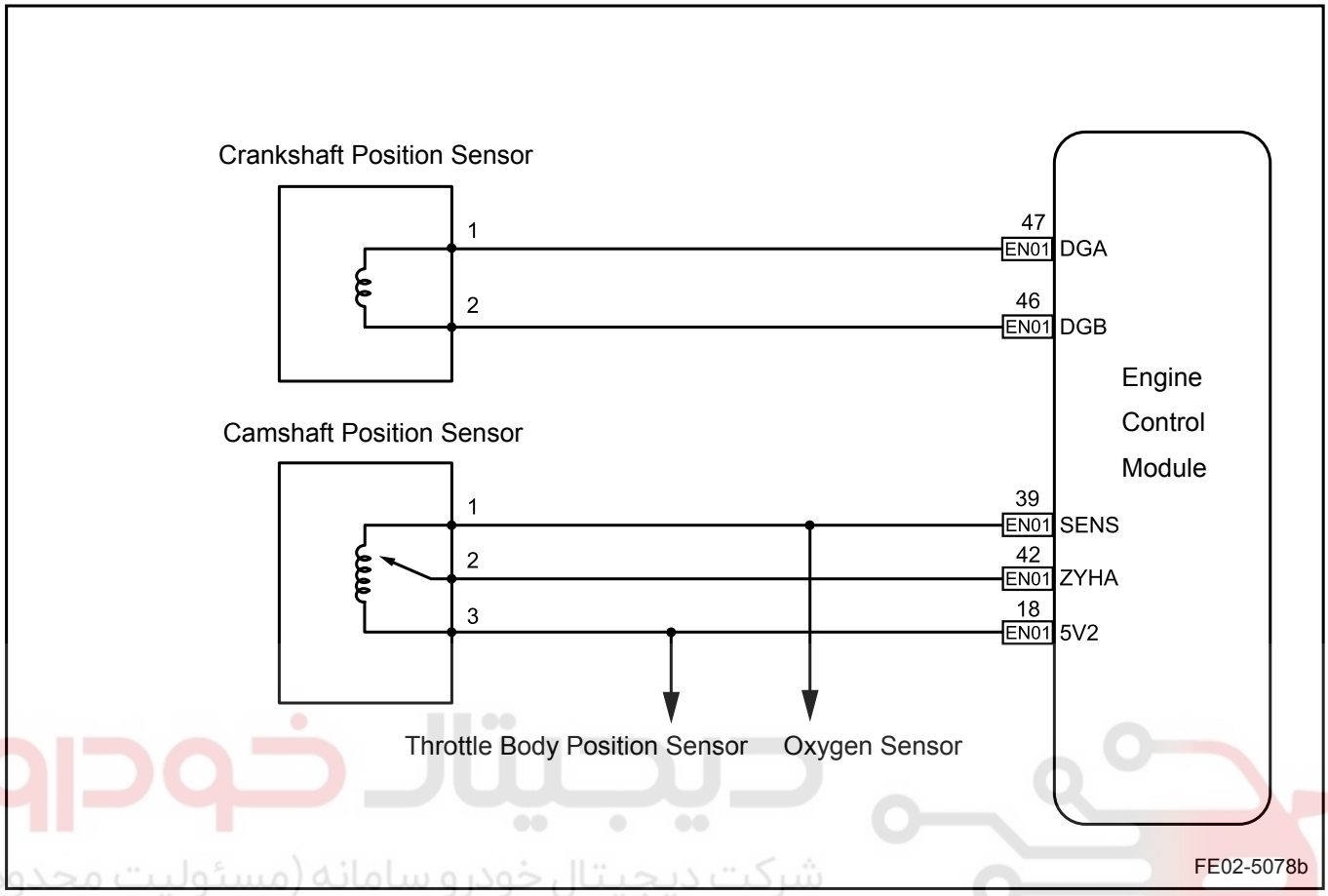
CKP sensor signal provides ECM with current crankshaft speed and position. CKP sensor produces an alternating voltage with changing amplitude and frequency. Frequency depends on the crankshaft speed and the AC output voltage depends on the CKP. CKP sensor works with a fixed 58X variable reluctance rotor on the crankshaft. ECM calculates the ignition timing, injection timing and controls knock ignition according to CKP sensor and camshaft position sensor input signal. CKP sensor is also used to detect misfire and tachometer display. ECM uses CAN network to send the engine speed signal to the instrument panel.

CKP sensor signal passes through the CKP sensor harness connector EN26 terminal No.1 and No.2 to ECM harness connector EN01 terminal No.47 and 46.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0321 | Hardware Circuit Checks | 1. Frequently add teeth to adjust.<br>2. Frequently reduce teeth to adjust.<br>3. Speed sensor signal exists but there is no reference.<br>4. Frequently lose the reference. | 1. The count of adding a tooth is greater than 250 times.<br>2. The count of reducing a tooth is greater than 250 times.<br>3. The count of no record of the teeth missing is more than 6 times.<br>4. The count of losing the missing teeth is greater than 2000 times. |
| P0322 | Hardware Circuit Checks | No speed sensor signal is monitored after a certain number of phases. | 1. Phase signal transition count is greater than 18 times.<br>2. A low engine speed. |

3. Schematic:




4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Initial Inspection |

(a) Check the sensor wiring harness connector EN26 whether there is loose or poor connection and so on.
(b) Check whether the sensor is installed correctly.
(c) Check whether the sensor gap is normal.

No → Fault location. Go to step 10

Yes

| | |
|---|---|
| Step 2 | Read the engine data (engine speed) on the scan tool. |

(a) Connect scan tool to datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Select "Engine"/"Reading Data"/"Engine Speed."
(d) Start the engine.
(e) With the engine running, read the engine data on the scan tool.

Standard Value: Normal data. Refer to 2.2.7.9 Data Stream List

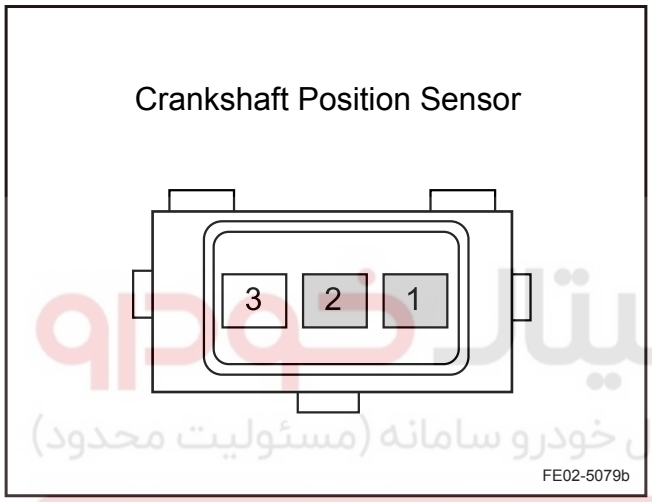
(f) If the engine does not start, check the data with the engine running.

(g) If the engine speed is shown as "0", it indicates the circuit between the crankshaft position sensor and ECM wiring harness open or short.

Yes → Go to step 4

No

| | |
|---|---|
| Step 3 | Intermittent Fault. Refer to 2.2.7.4 Fault Symptom Table. |
| Step 4 | Check the sensor. |




(a) Turn the ignition switch to "OFF" position.

(b) Disconnect the crankshaft position sensor wiring harness connector EN26.

(c) Measure crankshaft position sensor resistance.

Standard Resistance: 774-946 Ω at 23°C (73.4 °F)

(d) Connect the crankshaft position sensor wiring harness connector EN26.

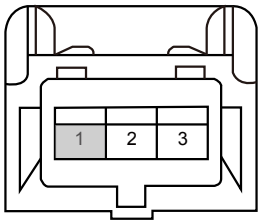
Is resistance normal?

No → Replace the crankshaft position sensor. Refer to 2.10.8.2 Crankshaft Position Sensor Replacement. Go to step 10

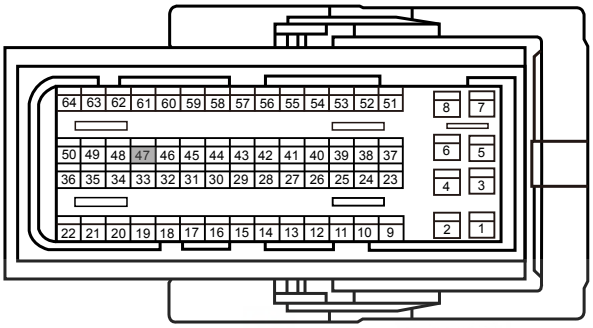
Yes

| | |
|---|---|
| Step 5 | Check sensor terminal No.1 circuit. |

Crankshaft Position Sensor Harness Connector EN26




ECM Harness Connector EN01




FE02-5080b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the crankshaft position sensor wiring harness connector EN26.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between crankshaft position sensor wiring harness connector EN26 terminal No.1 and ECM harness connector EN01 terminal No.47. Check whether the circuit is open.
(e) Measure resistance between crankshaft position sensor wiring harness connector EN26 terminal No.1 and a reliable ground. Check whether the circuit is short to ground.
(f) Measure resistance between crankshaft position sensor wiring harness connector EN26 terminal No.1 and power supply. Check whether the circuit is short to power supply.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN26 (1) and EN01 (47) | Less than 1 Ω |
| Resistance Between EN26 (1) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN26 (1) and a Reliable Ground | 0 V |

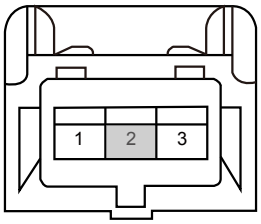
Are the values specified values?

No → Repair the faulty part. Go to step 10

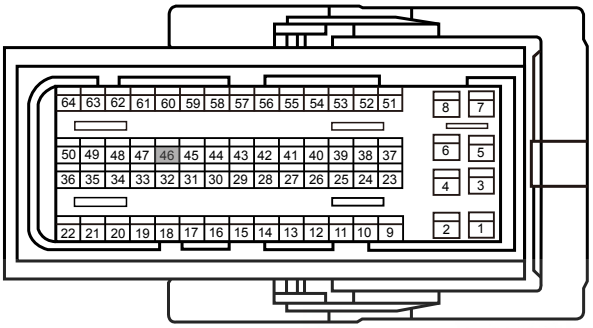
Yes

| | |
|---|---|
| Step 6 | Check sensor terminal No.2 circuit. |

Crankshaft Position Sensor Harness Connector EN26




ECM Harness Connector EN01

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(a) Turn the ignition switch to "OFF" position.
(b) Disconnect the crankshaft position sensor wiring harness connector EN26.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between crankshaft position sensor wiring harness connector EN26 terminal No.2 and ECM harness connector EN01 terminal No.46. Check whether the circuit is open.
(e) Measure resistance between crankshaft position sensor wiring harness connector EN26 terminal No.2 and a reliable ground. Check whether the circuit is short to ground.
(f) Measure resistance between crankshaft position sensor wiring harness connector EN26 terminal No.2 and power supply. Check whether the circuit is short to power supply.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN26 (2) and EN01 (46) | Less than 1 Ω |
| Resistance Between EN26 (2) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN26 (2) and a Reliable Ground | 0 V |

Are the values the specified values?

No → Repair the faulty part. Go to step 10

Yes

| | |
|---|---|
| Step 7 | Check sensor signal plate. |

(a) Check whether the sensor signal plate is damaged, missing and so on.
(b) Check whether the sensor signal plate is installed correctly.

No → Repair the faulty part. Go to step 10

Yes

| | |
|---|---|
| Step 8 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 9 | Replace ECM. |

Next

| | |
|---|---|
| Step 10 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 10 min.
(f) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 11 | Diagnostic completed. |

5. Repair Instructions:

Replace crankshaft position sensor. Refer to 2.10.8.2 Crankshaft Position Sensor Replacement.

## 2.2.7.30 DTC P0327 P0328

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0327 | Knock sensor signal circuit voltage is too low |
| DTC | P0328 | Knock sensor signal circuit voltage is too high |

KS sensor to ECM feedback signal helps ECM control the ignition timing to achieve the optimal operation and the ignition system to achieve the best performance, as well as to prevent damage to the engine by a potential knock. KS sensor is located below the intake manifold on the cylinder. KS sensor voltage changes with the AC signal generated by the vibration with running engine. Engine control module adjusts spark timing according to KS sensor signal amplitude and frequency.

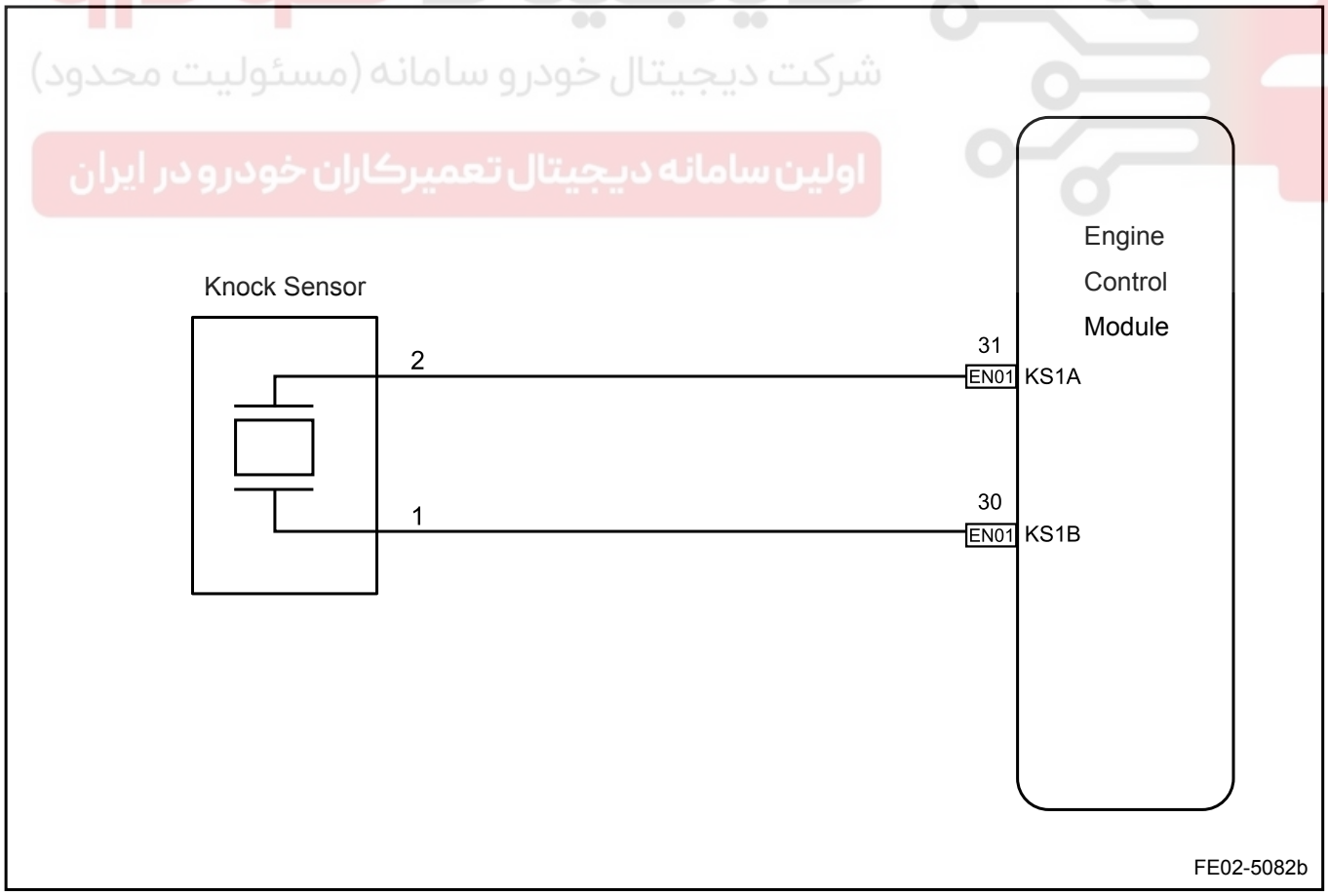
ECM receives signals from KS sensor harness connector EN08 terminal No.1 and 2 through ECM harness connector EN01 terminal No.30 and 31.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|

| | | | |
|---|---|---|---|
| P0327 | Signal Range Too Low | 1. Knock identification reference voltage is 0.35-0.60 V.<br>2. It occurs for more than 30 times successively.<br>3. Engine coolant temperature is greater than 40°C (104 °F).<br>4. Engine speed is greater than 2,600 rpm.<br>5. Cylinder No.1 can be identified. | 1. Sensor Circuit<br>2. Sensor<br>3. ECM |
| P0328 | Signal Range Too Low | 1. Knock identification reference voltage is 36-150 V.<br>2. It occurs more than 30 times successively.<br>3. Knock control circuit has no malfunction.<br>4. Jolt-limited feature is not activated.<br>5. Engine load is greater than 39.8%. | |

3. Schematic:



4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Initial Inspection |

(a) Check whether there is KS sensor physical damage.
(b) Check whether KS sensor is installed correctly. Torque is set too tight or too loose will trigger DTC codes.
(c) Check KS sensor installation surface whether there are glitches, casting flash and foreign matter.
(d) Knock sensor must be kept away from hoses, brackets and engine wires.

Are above mentioned parts normal?

No → Repair the faulty part. Go to step 9

Yes

| | |
|---|---|
| Step 2 | Read the engine data (engine speed) on the scan tool. |

(a) Connect scan tool to datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Select "Engine"/"Read Data"/"Knock Sensor Signal 1".
(d) Start and run the engine at normal working temperature.
(e) Road test the vehicle and read the engine speed data on the scan tool.

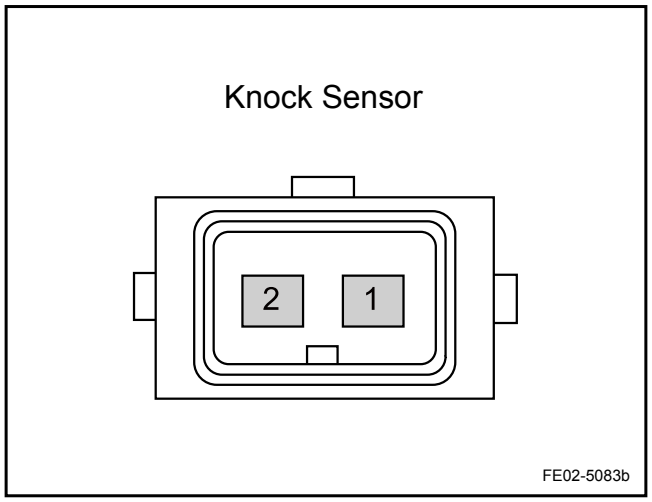
Is data normal?

Standard Value: Normal data. Refer to 2.2.7.9 Data Stream List

No → Go to step 4

Yes

| | |
|---|---|
| Step 3 | Intermittent Fault. Refer to 2.2.7.4 Fault Symptom Table. |
| Step 4 | Check the knock sensor. |

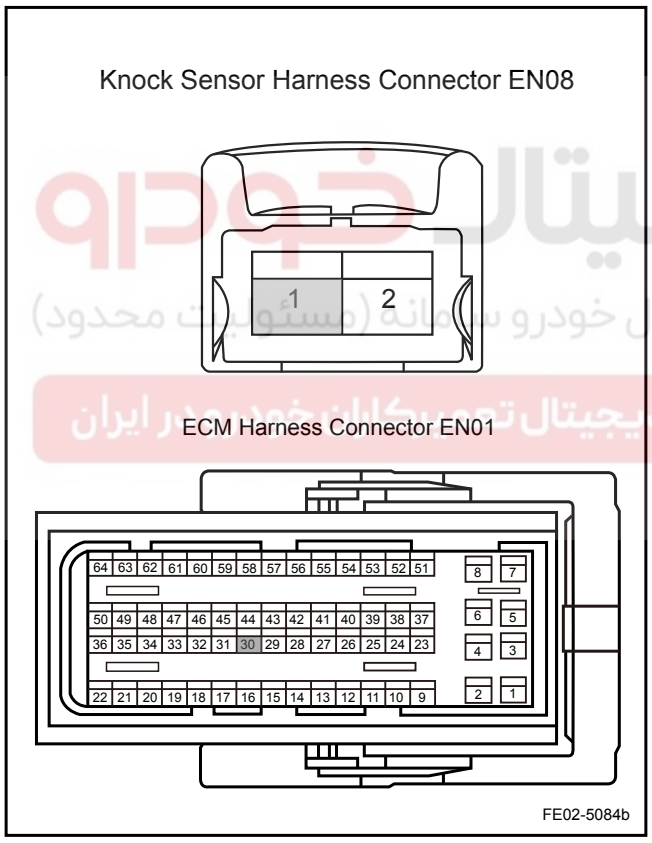



(a) Turn the ignition switch to "OFF" position.
(b) Disconnect Knock Sensor harness connector EN08.
(c) Measure knock sensor resistance.
Standard Resistance: 49 kΩ at 20°C (68 ºF)
(d) Connect Knock Sensor harness connector EN08.
Is resistance normal?

No → Replace the knock sensor. Refer to 2.10.8.5 Knock Sensor Replacement. Go to step 9

Yes

| | |
|---|---|
| Step 5 | Check sensor terminal No.1 circuit. |




(a) Turn the ignition switch to "OFF" position.
(b) Disconnect Knock Sensor harness connector EN08.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between knock sensor harness connector EN08 terminal No.1 and ECM harness connector EN01 terminal No.30. Check whether the circuit is open.
(e) Measure resistance between knock sensor harness connector EN08 terminal No.1 and a reliable ground. Check whether the circuit is short to ground.
(f) Measure voltage between knock sensor harness connector EN08 terminal No.1 and power supply. Check whether the circuit is short to power supply.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN08 (1) and EN01 (30) | Less than 1 Ω |
| Resistance Between EN08 (1) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN08 (1) and a Reliable Ground | 0 V |

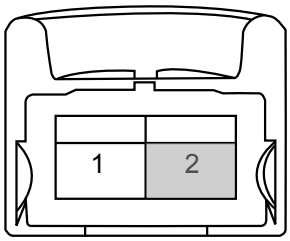
Are the values specified values?

No → Repair the faulty part. Go to step 9

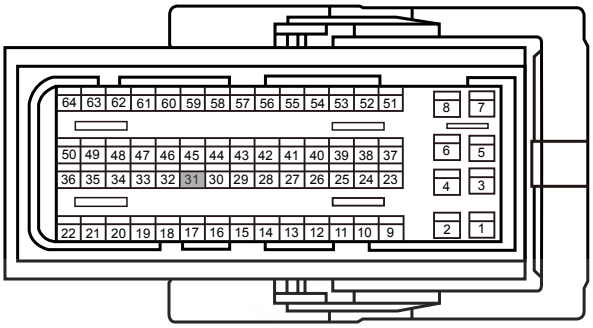
Yes

| | |
|---|---|
| Step 6 | Check sensor terminal No.2 circuit. |

Knock Sensor Harness Connector EN08




ECM Harness Connector EN01

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(a) Turn the ignition switch to "OFF" position.
(b) Disconnect Knock sensor harness connector EN08.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between knock sensor harness connector EN08 terminal No.2 and ECM harness connector EN01 terminal No.31. Check whether the circuit is open.
(e) Measure resistance between knock sensor harness connector EN08 terminal No.2 and a reliable ground. Check whether the circuit is short to ground.
(f) Measure voltage between knock sensor harness connector EN08 terminal No.2 and power supply. Check whether the circuit is short to power supply.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN08 (2) and EN01 (31) | Less than 1 Ω |
| Resistance Between EN08 (2) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN08 (2) and a Reliable Ground | 0 V |

Are the values specified values?

No → Repair the faulty part. Go to step 9

Yes

| | |
|---|---|
| Step 7 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 8 | Replace ECM. |

Next

| | |
|---|---|
| Step 9 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 10 min.
(f) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 10 | Diagnostic completed. |

5. Repair Instructions:

Replaced the knock sensor. Refer to 2.10.8.5 Knock Sensor Replacement.

## 2.2.7.31 DTC P0340-P0343

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0340 | Camshaft Position Sensor Incorrectly Installed |
| DTC | P0341 | Camshaft Position Sensor Poor Connection |
| DTC | P0342 | Camshaft Position Sensor Circuit Short to Ground |
| DTC | P0343 | Camshaft Position Sensor Circuit Short to Power Supply |

CMP links the crankshaft position to the camshaft position, so that ECM calculates cylinder No.1 compression TDC and determines at what time to which cylinder spray fuel.

Camshaft position sensor circuit includes the following:

- Reference Voltage: ECM provides a reference voltage to CMP sensor harness connector EN15 terminal No.1 via ECM harness connector EN01 terminal No.39.
- Signal Circuit: ECM receives signal voltage from CMP sensor harness connector EN15 terminal No.2 via ECM harness connector EN01 terminal No.42.

ECM Low Reference Voltage Circuit: ECM provides a low reference voltage to CMP sensor harness connector EN15 terminal No. 3 via ECM harness connector EN01 terminal No.14 and 18.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0340 | Poor Connection | 1. Phase signal register value is equal to 255, or equal to 0.<br>2. Phase signal transition count is greater than 4. | 1. Sensor Circuit<br>2. Sensor<br>3. ECM |
| P0341 | Poor Connection | Phase signal register value is greater than 0 and less than 255 at the same time does not equal 170 and 85. | |
| P0342 | Short to Ground | Phase signal register value is equal to 0. | |
| P0343 | Short to Power Supply | Phase signal register value is equal to 255. | |

3. Schematic:

Refer to 2.2.7.29 DTC P0321 P0322.

4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

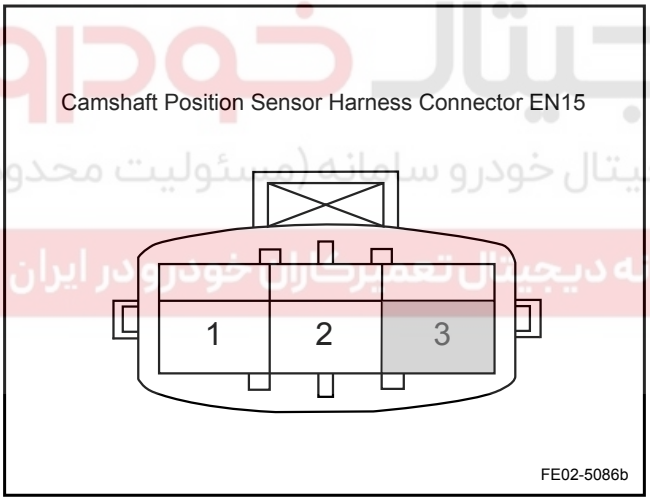
| Step 1 | Initial Inspection |
|---|---|

(a) Check the sensor wiring harness connector EN15 whether there is loose or poor connection and so on.
(b) Check whether the sensor is installed correctly.
(c) Check whether the sensor gap is normal.
Are above mentioned parts normal?

No → Repair the faulty part. Go to step 12

Yes

| Step 2 | Measure sensor 5 V reference voltage. |
|---|---|

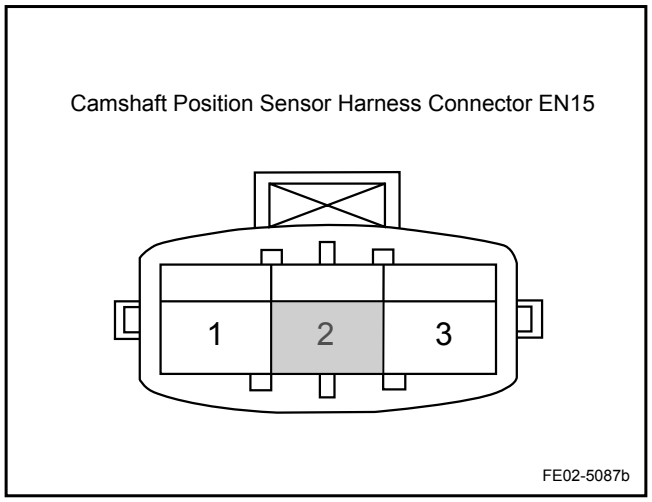



(a) Turn the ignition switch to "OFF" position.
(b) Disconnect camshaft position sensor wiring harness connector EN15.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between camshaft position sensor wiring harness connector EN15 terminal No.3 and a reliable ground.
Standard Voltage: 4.5-5.5 V
(e) Connect camshaft position sensor wiring harness connector EN15.
Is the value specified value?

No → Go to step 6

Yes

| Step 3 | Measure the sensor signal circuit. |
|---|---|




(a) Turn the ignition switch to "OFF" position.
(b) Disconnect camshaft position sensor wiring harness connector EN15.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between camshaft position sensor wiring harness connector EN15 terminal No.2 and a reliable ground.

Standard Voltage: 4.5-5.5 V

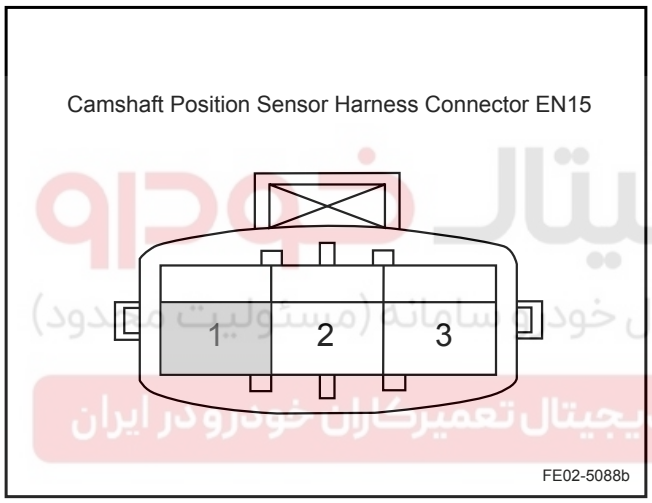
(e) Connect camshaft position sensor wiring harness connector EN15.

Is the value specified value?

No → Go to step 7

Yes

| | |
|---|---|
| Step 4 | Test ECM internal low reference circuit. |




(a) Turn the ignition switch to "OFF" position.
(b) Disconnect camshaft position sensor wiring harness connector EN15.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between camshaft position sensor wiring harness connector EN15 terminal No.1 and a reliable ground.

Standard Resistance: Less than 3 Ω

(e) Connect camshaft position sensor wiring harness connector EN15.

Is the value specified value?

No → Go to step 8

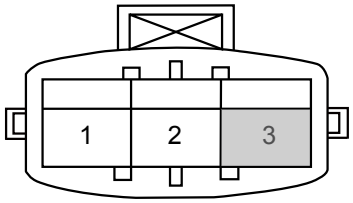
Yes

| | |
|---|---|
| Step 5 | Replace the camshaft position sensor. Refer to 2.10.8.1 Camshaft Position Sensor Replacement. |

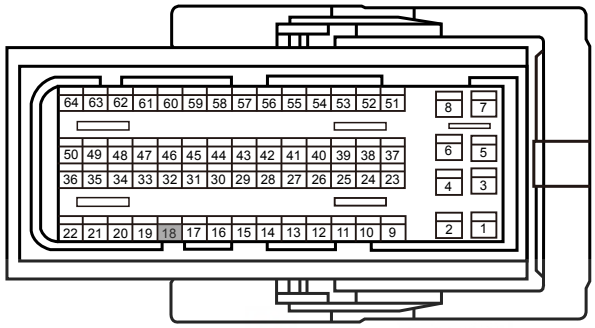
Next → Go to step 12

| | |
|---|---|
| Step 6 | Check the sensor 5 V reference voltage circuit. |

Camshaft Position Sensor Harness Connector EN15




ECM Harness Connector EN01




FE02-5089b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect camshaft position sensor wiring harness connector EN15.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between camshaft position sensor harness connector EN015 terminal No.3 and ECM harness connector EN01 terminal No.18. Check whether the circuit is open.
(e) Measure resistance between camshaft position sensor harness connector EN015 terminal No.3 and a reliable ground. Check whether there is short to ground circuit.
(f) Measure voltage between camshaft position sensor harness connector EN015 terminal No.3 and power supply. Check whether there is short to power supply circuit.

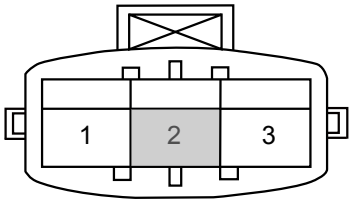
| Test Items | Standard Value |
|---|---|
| Resistance Between EN15 (3) and EN01 (18) | Less than 1 Ω |
| Resistance Between EN15 (3) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN15 (3) and a Reliable Ground | 0 V |

Execute next step as per normal.

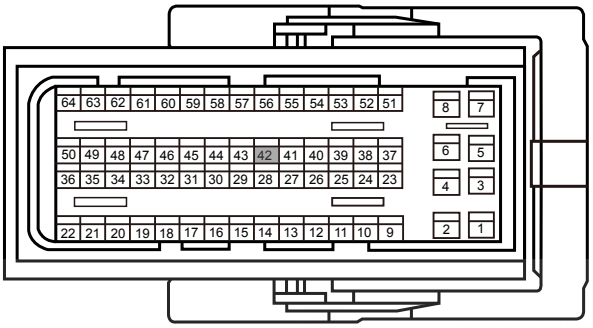
| | |
|---|---|
| Next | Repair the faulty part. Go to step 12 |

| | |
|---|---|
| Step 7 | Check sensor signal circuit. |

Camshaft Position Sensor Harness Connector EN15




ECM Harness Connector EN01




FE02-5090b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect camshaft position sensor wiring harness connector EN15.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between camshaft position sensor harness connector EN015 terminal No.2 and ECM harness connector EN01 terminal No.42. Check whether the circuit is open.
(e) Measure resistance between camshaft position sensor harness connector EN015 terminal No.2 and a reliable ground. Check whether the circuit is short to ground.
(f) Measure resistance between camshaft position sensor harness connector EN015 terminal No.2 and power supply. Check whether the circuit is short to power supply.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN15 (2) and EN01 (42) | Less than 1 Ω |
| Resistance Between EN15 (2) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN15 (2) and a Reliable Ground | 0 V |

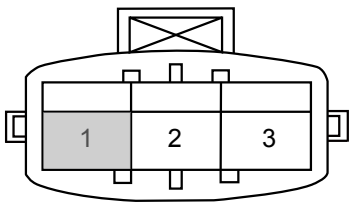
Are the values specified values?

No → Repair the faulty part. Go to step 12

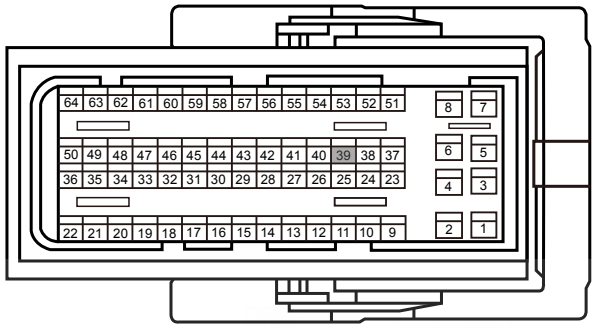
Yes

| | |
|---|---|
| Step 8 | Check ECM internal low reference circuit. |

Camshaft Position Sensor Harness Connector EN15




ECM Harness Connector EN01




FE02-5091b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect camshaft position sensor wiring harness connector EN15.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between camshaft position sensor wiring harness connector EN15 terminal No.1 and ECM harness connector EN01 terminal No.39. Check whether the circuit is open.
(e) Measure voltage between camshaft position sensor wiring harness connector EN15 terminal No.1 and a reliable ground. Check whether the circuit is short to power supply.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN15 (1) and EN01 (39) | Less than 1 Ω |
| Voltage Between EN15 (1) and a Reliable Ground | 0 V |

Execute next step as per normal.

Next

| | |
|---|---|
| Step 9 | Check whether camshaft signal plate is normal. |

No → Repair the faulty part. Go to step 12

Yes

| | |
|---|---|
| Step 10 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 11 | Replace ECM. |

Next

| | |
|---|---|
| Step 12 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 13 | Diagnostic completed. |

5. Repair Instructions:

Replace the CMP sensor. Refer to 2.10.8.1 Camshaft Position Sensor Replacement.

## 2.2.7.32 DTC P0420

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0420 | Three-way Catalytic Converter Oxygen Storage Capacity Aging (Emission Over the Limit) |

ECM uses two oxygen sensors (Pre-Catalytic oxygen sensor and Post-Catalytic oxygen sensor) installed before and after the three-way catalytic converters to monitor the conversion efficiency of the three-way catalytic converter (TWC). ECM uses Pre-Catalytic oxygen sensor for Air-Fuel ratio close-loop control and monitors oxygen content in the exhaust gas not purified by TWC. The Post-Catalytic oxygen sensor sends voltage signal to ECM indicating the oxygen content in the exhaust gas purified by the TWC. ECM compares signals from the two sensors to determine whether the TWC is currently under normal working condition. If the calculated TWC conversion efficiency is too low, the fault lamp will be lit and the DTC code will be set.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0420 | Exceed the Maximum Limit | 1. After adjustment, the post-catalytic oxygen sensor signal is greater than the average amplitude, which is 0.48 V.<br>2. Catalytic converter monitoring activation time is greater than 70 s. | 1. Pre-Catalytic Oxygen Sensor<br>2. Post-Catalytic Oxygen Sensor<br>3. Three-way Catalytic Converter<br>4. Exhaust Leakage |

3. Schematic:

Refer to 2.2.6.1 Schematic

4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Check whether there are control system DTC codes other than DTC P0420. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Press the scan tool power button.
(d) Select the following menu items: Engine/Read DTC codes.
(e) Read DTC codes.

| DTC Codes Shown | To Step |
|---|---|
| DTC P0420 | Yes |
| DTC Code Other Than DTC P0420 | No |

No → Refer to 2.2.7.11 DTC Code Index

Yes

| | |
|---|---|
| Step 2 | Start the engine and turn on the scan tool. |

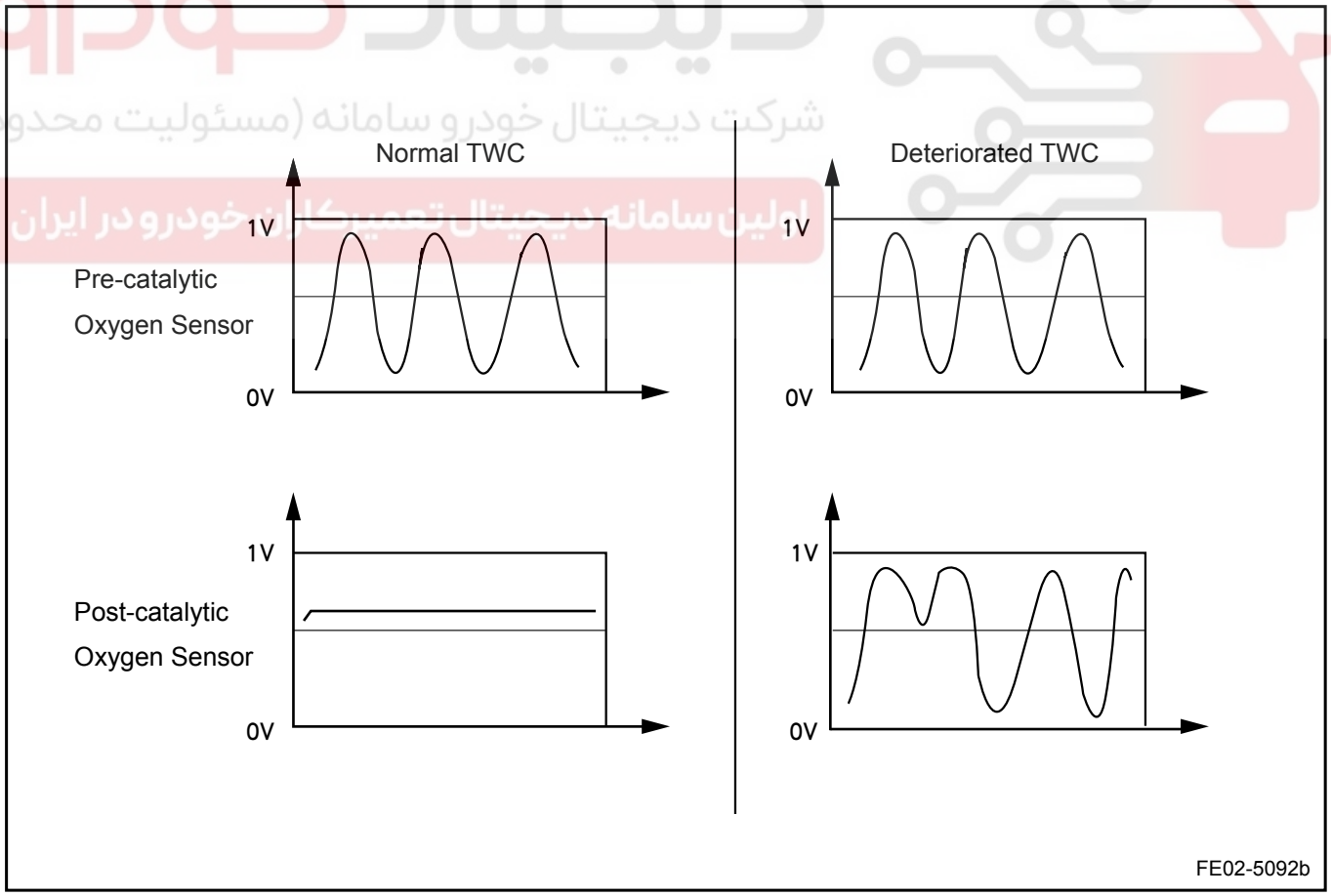
Next

| | |
|---|---|
| Step 3 | Keep the engine speed at 2,500 rpm for more than 2 min to warm up the engine, until the engine coolant temperature reaches 80°C (176 ºF). |

Next

| | |
|---|---|
| Step 4 | Select on the scan tool: Engine/Read data/Group 1 oxygen sensor voltage 1 (Pre-Catalytic oxygen sensor), Group 1 oxygen sensor voltage 2 (Post-Catalytic oxygen sensor) |

Next



| Step 5 | Observe Pre-Catalytic oxygen sensor and Post-Catalytic oxygen sensor output voltages. |
|---|---|

Whether Pre-Catalytic oxygen sensor and Post-Catalytic oxygen sensor signal voltage is matching "Normal TWC" in the figure?

Yes → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

No

Warning!

Propane gas is a flammable gas. It is strictly prohibited to operate propane gas near a fire, otherwise it will cause a fire.

| Step 6 | Test the oxygen sensor signal. |
|---|---|

(a) If the voltage data is consistently below 0.45 V (mixture too lean), carry out the steps as following:

- Spray proper amount of propane gas into the intake.
- Inspect whether the sensor voltage data changes significantly, as the signal voltage will increase rapidly.

| Pre-Catalytic Oxygen Sensor Signal Voltage | Post-Catalytic Oxygen Sensor Signal Voltage | To Step |
|---|---|---|
| Obvious Change | No Change | A |
| No Change | Obvious Change | B |
| Obvious Change | No Change | C |
| No Change | No Change | D |

B → Replace the pre-catalytic oxygen sensor. Refer to 2.4.7.2 Pre-Catalytic Oxygen Sensor Replacement. Go to step 11

C → Go to step 9

D → Check the cause for engine air-fuel ratio too lean/too rich. Refer to 2.2.7.4 Fault Symptom Table

A

| Step 7 | Check whether there is exhaust leakage. |
|---|---|

Yes → Repair the faulty part. Go to step 11

No

| Step 8 | Replace the three-way catalytic converter. Refer to 2.7.6.2 Three-way Catalytic Converter Replacement. |
|---|---|

Next → Go to step 11

| | |
|---|---|
| Step 9 | Check whether there is exhaust leakage. |

Yes → Repair the faulty part. Go to step 11

No

| | |
|---|---|
| Step 10 | Replace the post-catalytic oxygen sensor. Refer to 2.4.7.1 Post-Catalytic Oxygen Sensor Replacement. |

Next

| | |
|---|---|
| Step 11 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 10 min.
(f) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 12 | Diagnostic completed. |

## 2.2.7.33 DTC P0444 P0458 P0459

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0444 | Canister Control Valve Control Circuit Open |
| DTC | P0458 | Canister Control Valve Control Circuit Voltage Too Low |
| DTC | P0459 | Canister Control Valve Control Circuit Voltage Too High |

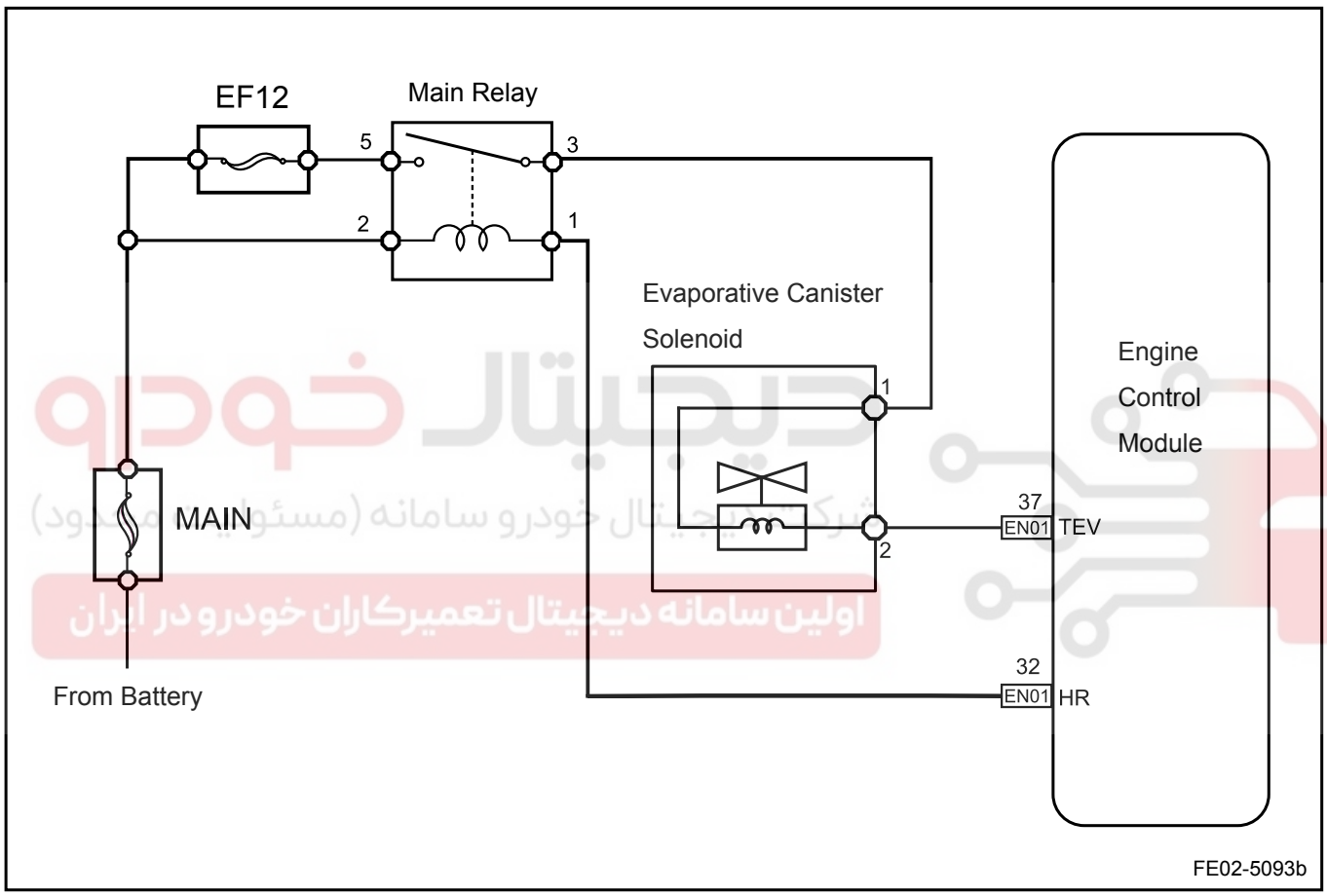
EVAP solenoid valve absorbs fuel vapor from the evaporative emission canister to the intake manifold. EVAP solenoid valve is controlled by the pulse width modulation (PWM). The circuit consists of:

- Operating Voltage: Battery voltage passes through ECM controlled main relay terminal No.3 to reach EVAP solenoid harness connector EN24 terminal No.1.
- ECM control circuit: EVAP solenoid valve wiring harness connector EN24 terminal No.2 is connected to ECM harness connector EN01 terminal No.37. ECM has an internal driver circuit to control the solenoid valve ground. Driver circuit is equipped with a ECM feedback circuit. ECM monitors the feedback voltage to determine whether the control circuit is open, short to ground or short to power supply.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0444<br>P0458<br>P0459 | Hardware Circuit Checks | 1. Circuit Open.<br>2. Circuit Short to Ground.<br>3. Circuit Short to Power Supply. | 1. Canister Solenoid Valve Circuit<br>2. Solenoid Valve<br>3. ECM |

3. Schematic:




4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| | |
|---|---|
| Step 1 | Test the Canister solenoid valve with a scan tool. |

(a) Connect scan tool to the "Data Link Connector".
(b) Disconnect the Canister solenoid valve to the Canister vacuum tubes.
(c) Start engine and turn on the scan tool.

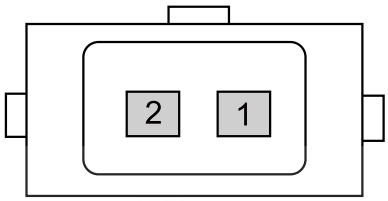
(d) Select the following menu: "Engine"/"Action Test"/"Canister Solenoid Valve".
(e) Use scan tool to enable the use of "Canister Control Valve". Place a finger over the vacuum port solenoid valve and check whether there is suction.

Yes → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

No

| Step 2 | Measure canister solenoid valve resistance. |
|---|---|

Evaporative Canister Solenoid




FE02-5094b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect canister solenoid valve harness connector EN24.
(c) Measure resistance between the canister solenoid valve two terminals.

Standard Resistance: 25 Ω at 20°C (68 °F)

(d) Connect canister solenoid valve harness connector EN24.

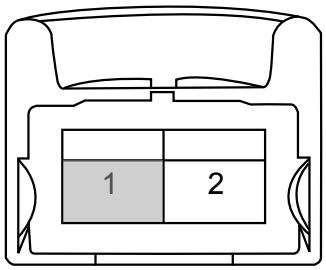
Is the value specified value?

No → Replace the canister solenoid valve. Refer to 2.4.7.3 Canister Solenoid Valve Replacement. Go to step 7

Yes

| Step 3 | Measure canister solenoid valve working power supply. |
|---|---|

Evaporative Canister Solenoid Harness Connector EN24




FE02-5095b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect canister solenoid valve harness connector EN24.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between canister solenoid valve wiring harness connector EN24 terminal No.1 and a reliable ground.

Standard Voltage: 11-14 V

(e) Connect canister solenoid valve harness connector EN24.

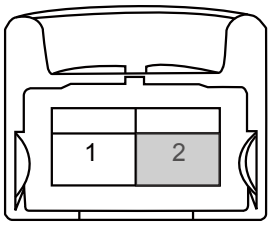
Is the value specified value?

No → Check whether there is an open circuit or a circuit short to ground between solenoid valve wiring harness connector EN10 terminal No. 1 and main relay terminal No.3. Repair the faulty part. Go to step 7

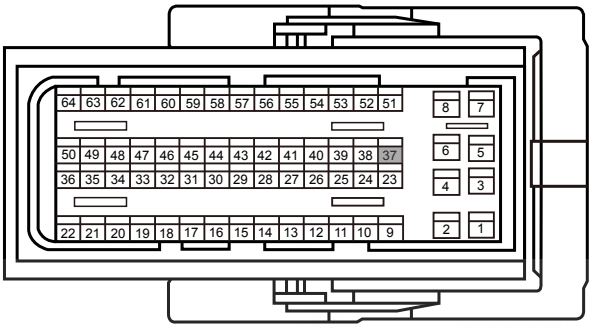
Yes

| Step 4 | Check canister solenoid valve control circuit. |
|---|---|

Evaporative Canister Solenoid Harness Connector EN24




ECM Harness Connector EN01




FE02-5096b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect canister solenoid valve harness connector EN24.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between canister solenoid valve wiring harness connector EN24 terminal No.2 and ECM harness connector EN01 terminal No.37. Check whether the circuit is open.
(e) Measure resistance between canister solenoid valve wiring harness connector EN24 terminal No.2 and a reliable ground. Check whether the circuit is short to ground.
(f) Measure voltage between canister solenoid valve wiring harness connector EN24 terminal No.2 and a reliable ground. Check whether the circuit is short to power supply.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN24 (2) and EN01 (37) | Less than 1 Ω |
| Resistance Between EN24 (2) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN24 (2) and a Reliable Ground | 0 V |

Are the values specified values?

No → Repair or replace the wiring harness connectors. Go to step 7

Yes

| | |
|---|---|
| Step 5 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 6 | Replace ECM. |

Next

| | |
|---|---|
| Step 7 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 8 | Diagnostic completed. |

5. Repair Instructions:

Replace EVAP solenoid valve. Refer to 2.4.7.3 Canister Solenoid Valve Replacement.

## 2.2.7.34 DTC P0480 P0481 P0691 P0692 P0693 P0694

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0480 | Cooling Fan Relay Control Circuit Open (Low Speed) |
| DTC | P0482 | Cooling Fan Relay Control Circuit Malfunction (High Speed) |
| DTC | P0691 | Cooling Fan Relay Control Circuit Short to Ground (Low Speed) |
| DTC | P0692 | Cooling Fan Relay Control Circuit Short to Power Supply (Low Speed) |
| DTC | P0693 | Cooling Fan Relay Control Circuit Short to Ground (High Speed) |
| DTC | P0694 | Cooling Fan Relay Control Circuit Short to Power Supply (High Speed) |

High or low speed cooling fan relay coil power is provided by ECM controlled main relay. ECM controls the relay via ECM harness connector EN01 terminal No.52 and 62. ECM has an internal driver circuit that controls the relay coil ground. Drive circuit is equipped with a feedback circuit to ECM. ECM monitors the feedback voltage control circuit to determine whether the control circuit is open, short to ground or short to ground.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0480 | Hardware Circuit Checks | Circuit Open. | 1. Relay Circuit<br>2. Relay<br>3. ECM |
| P0481 | Hardware Circuit Checks | Circuit Open. | |
| P0691 | Hardware Circuit Checks | Circuit Short to Ground. | |
| P0692 | Hardware Circuit Checks | Circuit Short to Power Supply. | |
| P0693 | Hardware Circuit Checks | Circuit Short to Ground. | |
| P0694 | Hardware Circuit Checks | Circuit Short to Power Supply. | |

3. Schematic:

Refer to 2.8.6.1 Schematic.

4. Diagnostic Steps:

Refer to 2.8.7.2 Cooling Fan Circuit Diagnosis.

5. Repair Instructions:

Replace the cooling fan. Refer to 2.8.8.3 Cooling Fan Replacement.

## 2.2.7.35 DTC P0501

1. DTC Descriptor:

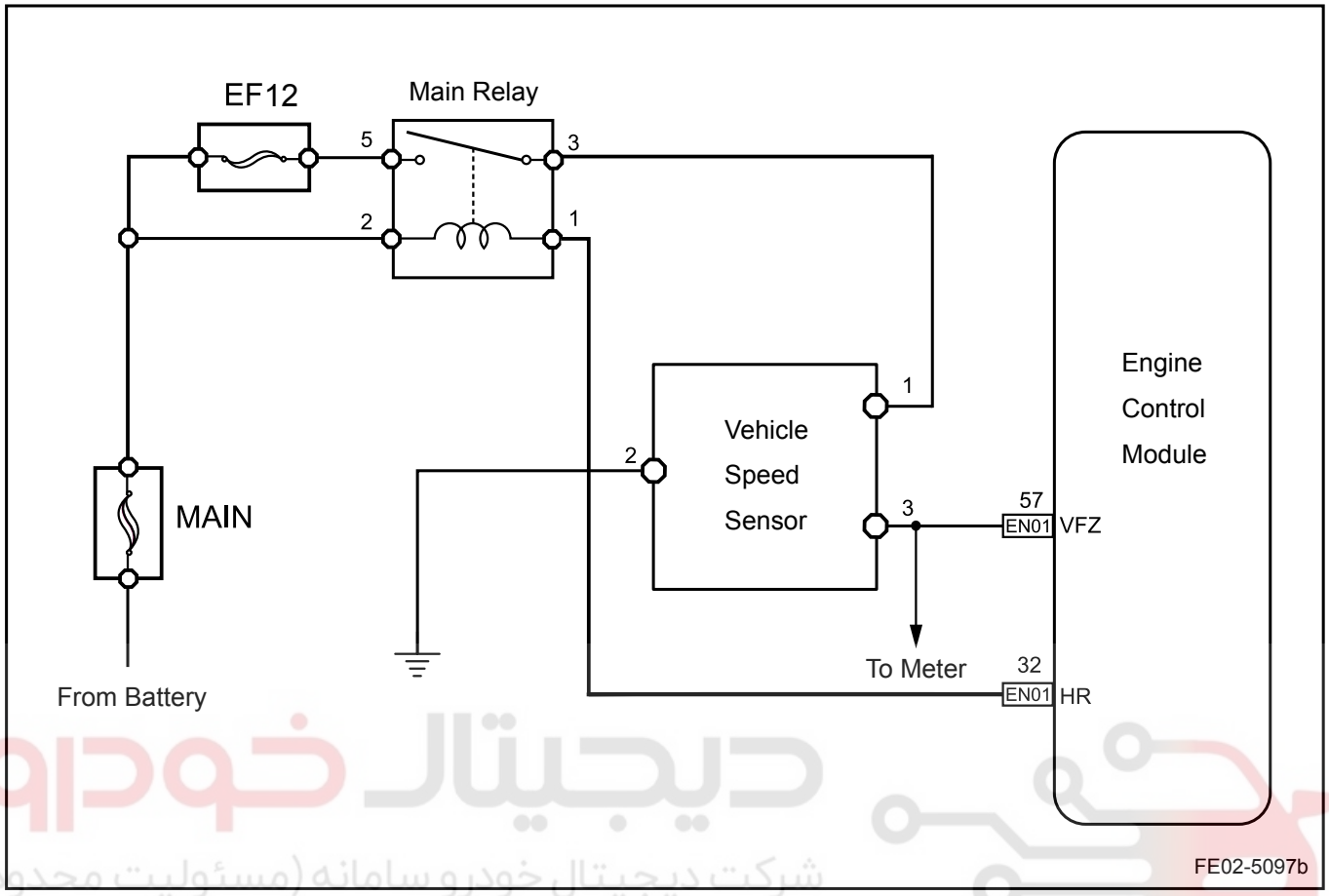
| | | |
|---|---|---|
| DTC | P0501 | Unreasonable Vehicle Speed Sensor Signal |

The vehicle speed signal is used to monitor the vehicle speed. The vehicle speed signal is one of the fuel control reference signals during an urgent deceleration. The vehicle speed sensor working voltage is provided by The Main Relay which is controlled by ECM via ECM harness connector EN01 terminal No.57. The vehicle speed sensor signal is sent to the instrument panel used for the vehicle speed display.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0501 | Low Limit for Stopping Fuel Supply | 1. The vehicle speed is less than 5 km/h.<br>2. Stopping Fuel Supply Enabled.<br>3. Engine coolant temperature is higher than 64.5°C. (148.1 °F) .<br>4. Engine speed is greater than 1,520 rpm and less than 4,000 rpm. | 1. Vehicle Speed Sensor Circuit<br>2. Vehicle Speed Sensor<br>3. ECM |

3. Schematic:




4. Diagnostic Steps:

| | |
|---|---|
| Step 1 | Road test the vehicle. Is the vehicle speed meter display working properly? |

(a) If the instrument panel displays the vehicle speed as per normal, the vehicle speed sensor is working correctly.

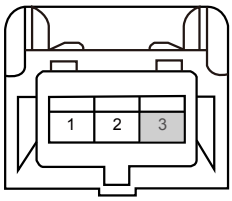
(b) If the instrument panel displays the vehicle speed abnormally, the vehicle speed sensor or the circuit may be faulty.

No → Go to step 3

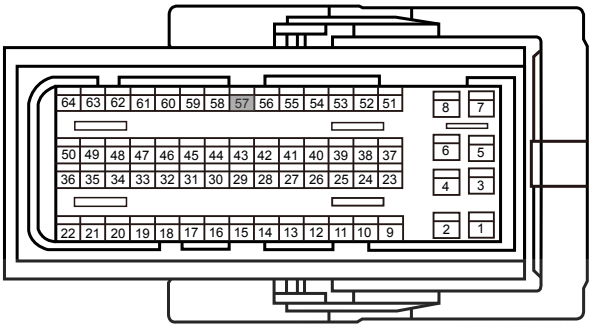
Yes

| | |
|---|---|
| Step 2 | Check the vehicle speed signal circuit. |

Vehicle Speed Sensor Harness Connector EN21




ECM Harness Connector EN01




FE02-5098b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect speed sensor wiring harness connector EN21.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between the vehicle speed sensor harness connector EN21 terminal No.3 and ECM harness connector EN01 terminal No.57. Check whether the circuit is open.
(e) Measure resistance between the vehicle speed sensor harness connector EN21 terminal No.3 and a reliable ground. Check whether the circuit is short to ground.
(f) Measure voltage between the vehicle speed sensor harness connector EN21 terminal No.3 and power supply. Check whether the circuit is short to power supply.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN21 (2) and EN01 (57) | Less than 1 Ω |
| Resistance Between EN21 (2) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN21 (2) and a Reliable Ground | 0 V |

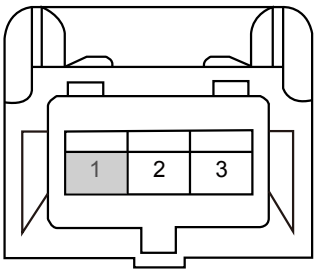
Are the values specified values?

No → Repair or replace the wiring harness connector. Go to step 8

Yes → Go to step 6

| Step 3 | Check the vehicle speed sensor power supply circuit. |
|---|---|

Vehicle Speed Sensor Harness Connector EN21




FE02-5099b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect speed sensor wiring harness connector EN21.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between vehicle speed sensor harness connector EN21 terminal No.1 and a reliable ground.

Standard Voltage: 11-14 V

(e) Connect vehicle speed sensor harness connector EN21.

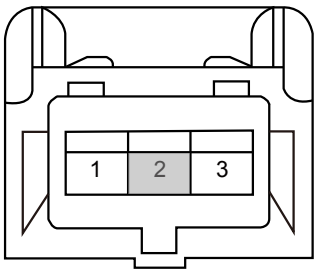
Is the value specified value?

No → Check whether there is a short circuit between the vehicle speed sensor terminal No.3 and the main relay terminal No.87. Repair the faulty part.

Yes

| Step 4 | Check the vehicle speed sensor ground circuit. |
|---|---|

Vehicle Speed Sensor Harness Connector EN21




FE02-5100b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect speed sensor wiring harness connector EN21.
(c) Measure resistance between vehicle speed sensor harness connector EN21 terminal No.2 and a reliable ground. Check whether the circuit is short to ground.

Standard Resistance: Less than 1 Ω

Is the value specified value?

No → Check whether there is an open circuit between the vehicle speed sensor terminal No.2 and a reliable ground. Repair the faulty part.

Yes

| | |
|---|---|
| Step 5 | Replace the vehicle speed sensor. |

Next → Go to step 8

| | |
|---|---|
| Step 6 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 7 | Replace ECM. |

Next

| | |
|---|---|
| Step 8 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 9 | Diagnostic completed. |

## 2.2.7.36 DTC P0506-P0509 P0511

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0506 | Controlled Idle Speed Lower Than Target Idle Speed |
| DTC | P0507 | Controlled Idle Speed Higher Than Target Idle Speed |
| DTC | P0508 | Stepper Motor Driver Pin Short to Ground |
| DTC | P0509 | Stepper Motor Driver Pin Short to Power Supply |
| DTC | P0511 | Stepper Motor Driver Pin Circuit Open |

ECM controls the engine idle speed by regulating the IAC valve core shaft position. IAC valve's two internal coils are driven by the stepper motors. idle air control valve's move is controlled by 4 circuits. ECM's driver controls idle air control valve two wires polarity via these circuits. ECM commands the IAC valve stepper motor rotate clockwise or counterclockwise. IAC valve motor is connected to the idle air control spool shaft through the driver screw. ECM sends electrical pulses to the IAC valve coils to allow the core shaft stretch into or contract out of the throttle body channel. Through the core shaft, air flow increases, so the engine speed increases. When the pivotal stretches, the air flow decreases, therefore the engine speed is reduced. If the engine control module detects the engine speed is not in the expected range, the DTC codes will be set.

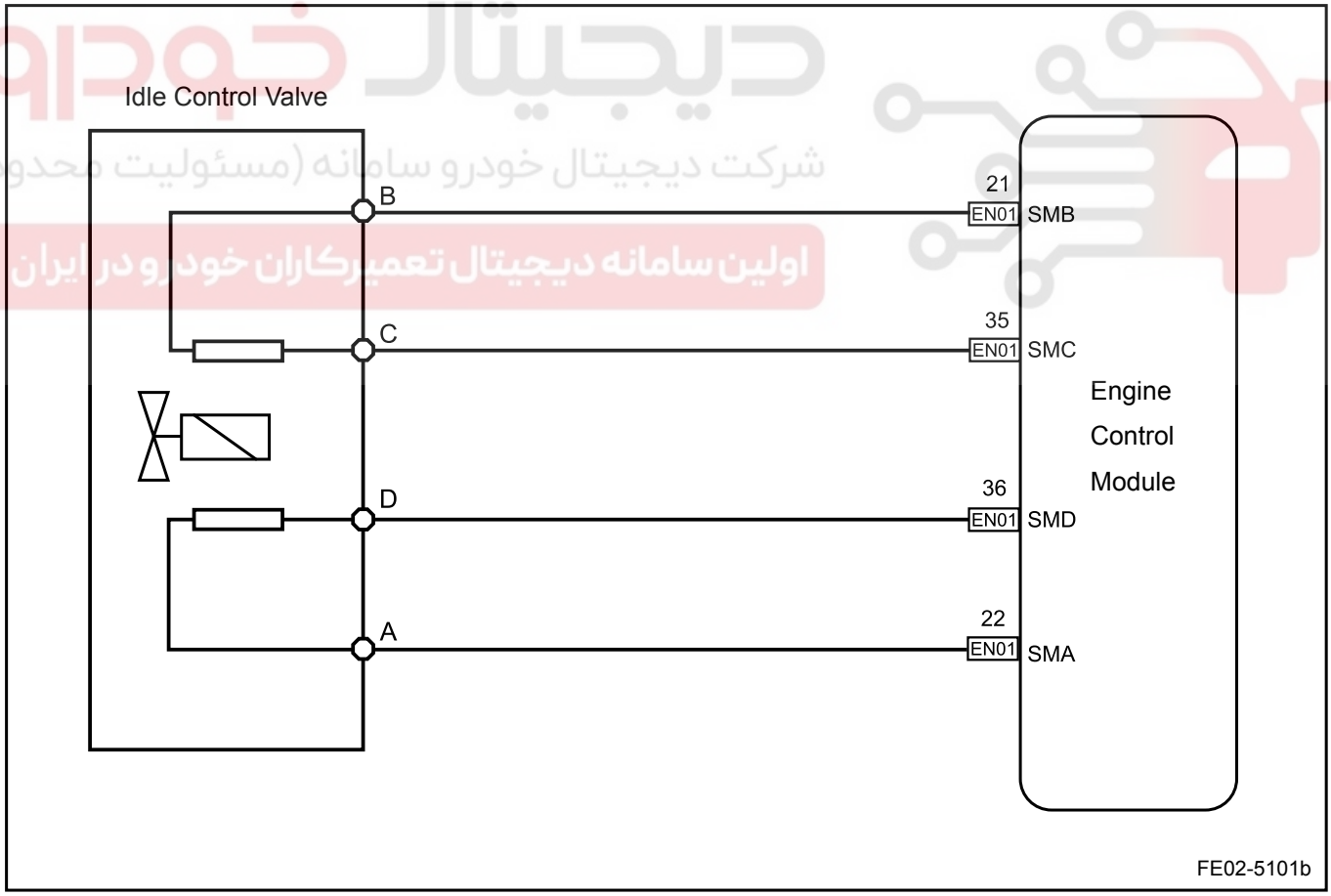
ECM harness connector EN01 terminals No. 21,22,35,36 are connected to IAC valve harness connector EN17 terminals B, A, C, D.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0506 | Idle actuator stays at a small opening position. | 1. Static target idle speed and the actual idle speed difference is less than 200 rpm.<br>2. Idle speed integral part is equal to the minimum.<br>3. Canister solenoid valve opening is less than 100%.<br>4. The engine is at idle speed.<br>5. The vehicle speed is equal to 0.<br>6. Engine coolant temperature is higher than 80.3°C (176.5 °F) .<br>7. Intake air temperature is higher than 20.3°C (68.5 °F). | 1. Idle Air Control Valve Circuit<br>2. Idle Speed Control Valve<br>3. Intake System<br>4. ECM |

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0507 | Idle actuator stays at a big opening position. | 1. Static target idle speed and the actual idle speed difference is less than 100 rpm.<br>2. Idle speed integral part is equal to the maximum.<br>3. Canister solenoid valve opening is less than 100%.<br>4. The engine is at idle speed.<br>5. The vehicle speed is equal to 0.<br>6. Engine coolant temperature is higher than 80.3°C (176.5 ºF) .<br>7. Intake air temperature is higher than 20.3°C (68.5 ºF). | |
| P0508 | Hardware Circuit Checks | One stepper motor pin is short to ground. | |
| P0509 | | One stepper motor pin is short to battery positive cable. | |
| P0511 | | One stepper motor pin is in an open circuit. | |

3. Schematic:



4. Diagnostic Steps:

Note

Before carrying out this diagnosis step, observe the data list on scan tool and analyze the accuracy of the data, as these will help with quick diagnosis.

| Step 1 | Use scan tool to carry out idle air control valve action test. |
|---|---|

(a) Connect scan tool to the datalink connector.
(b) Start engine and turn on the scan tool.
(c) Select the following: the "Engine"/"Action Test"/"Idle Speed Control".
(d) Use scan tool "Function Test" command to enable IAC valve opening. Increase the speed up to 1,800 rpm and decrease to 800 rpm, and then increase to 1,800 rpm.

Whether the engine speed follows the instructions rise and fall steadily?

Yes → Intermittent Fault. Refer to 2.2.7.4 Fault Symptom Table

No

| Step 2 | Check the following items. |
|---|---|

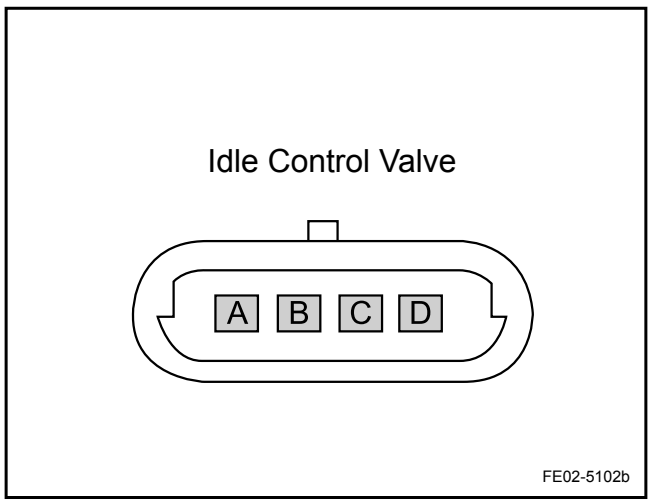
(a) Throttle body damage or blockage.
(b) Is idle air control channel blocked?
(c) Is there too much residue on the throttle?
(d) Is there too much residue on the throttle?
(e) Is there too much residue on the idle air control core shaft?
(f) Is intake blocked?

Any above mentioned fault?

Yes → Repair the faulty parts. Go to step 10

No

| Step 3 | Check idle speed control valve. |
|---|---|




(a) Turn the ignition switch to "OFF" position.
(b) Disconnect idle speed control valve wiring harness connector EN17.
(c) Measure idle speed control valve resistance.

| Tester Connection | Standard Value |
|---|---|
| AD, BC | 40-50 Ω |
| AC, BD | 10 kΩ or higher |

(d) Connect idle speed control valve wiring harness connector EN17.

Voltage normal?

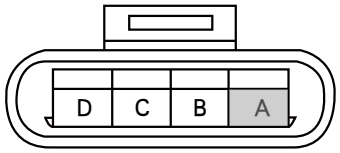
No

Replace idle speed control valve. Refer to 2.2.8.1 Idle Air Control Valve Replacement. Go to step 10

Yes

| Step 4 | Check idle speed control Valve terminal A circuit. |
|---|---|

Idle Control Valve Harness Connector EN17




ECM Harness Connector EN01


FE02-5103b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect idle speed control valve wiring harness connector EN17.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between idle speed control valve wiring harness connector EN17 terminal A and ECM harness connector EN01 terminal No.22. The standard value parameter is in the table below.
(e) Measure resistance between idle speed control valve wiring harness connector EN17 terminal A and a reliable ground. The standard value parameter is in the table below.
(f) Measure voltage between idle speed control valve wiring harness connector EN17 terminal A and a reliable ground. The standard value parameter is in the table below.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN17 (A) and EN01 (22) | Less than 1 Ω |
| Resistance Between EN17 (A) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN17 (A) and a Reliable Ground | 0 V |

Are the values specified values?

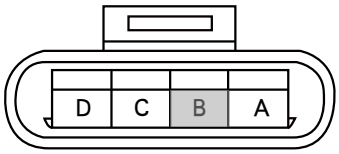
No

Repair or replace the wiring harness connector. Go to step 10

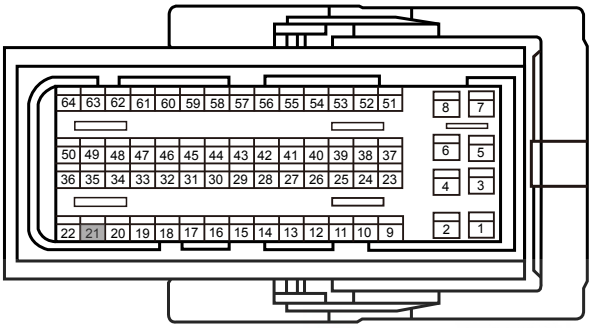
Yes

| Step 5 | Check idle speed control valve terminal B circuit. |
|---|---|

Idle Control Valve Harness Connector EN17




ECM Harness Connector EN01




FE02-5104b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect idle speed control valve wiring harness connector EN17.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between idle speed control valve wiring harness connector EN17 terminal B and ECM harness connector EN01 terminal No.21. The standard value parameter is in the table below.
(e) Measure resistance between idle speed control valve wiring harness connector EN17 terminal B and a reliable ground. The standard value parameter is in the table below.
(f) Measure voltage between idle speed control valve wiring harness connector EN17 terminal B and a reliable ground. The standard value parameter is in the table below.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN17 (B) and EN01 (21) | Less than 1 Ω |
| Resistance Between EN17 (B) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN17 (B) and a Reliable Ground | 0 V |

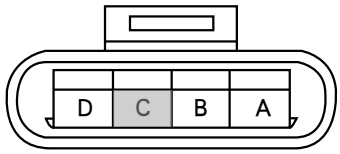
Are the values specified values?

No → Repair or replace the wiring harness connector. Go to step 10

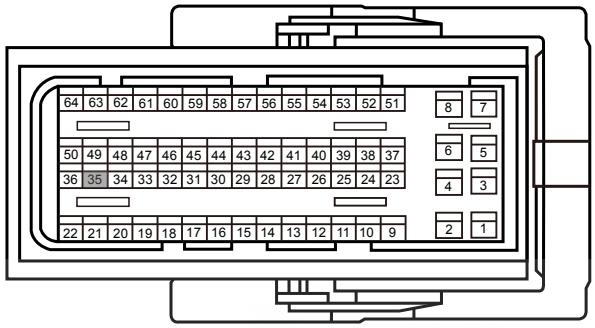
Yes

| | |
|---|---|
| Step 6 | Check idle speed control valve terminal C circuit. |

Idle Control Valve Harness Connector EN17




ECM Harness Connector EN01




FE02-5105b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect idle speed control valve wiring harness connector EN17.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between idle speed control valve wiring harness connector EN17 terminal C and ECM harness connector EN01 terminal No.35. The standard value parameter is in the table below.
(e) Measure resistance between idle speed control valve wiring harness connector EN17 terminal C and a reliable ground. The standard value parameter is in the table below.
(f) Measure voltage between idle speed control valve wiring harness connector EN17 terminal C and a reliable ground. The standard value parameter is in the table below.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN17 (C) and EN01 (35) | Less than 1 Ω |
| Resistance Between EN17 (C) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN17 (C) and a Reliable Ground | 0 V |

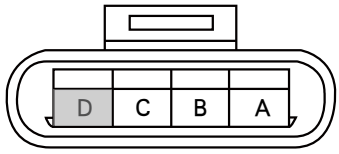
Are the values specified values?

No → Repair or replace the wiring harness connector. Go to step 10

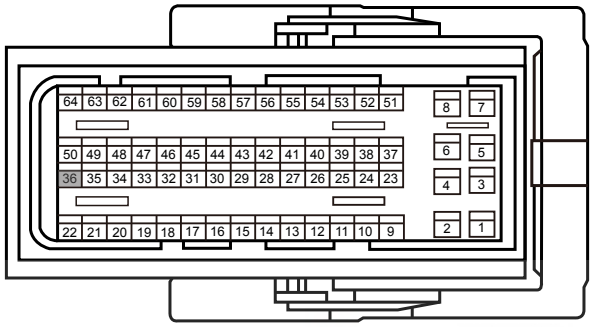
Yes

| | |
|---|---|
| Step 7 | Check idle speed control valve terminal D circuit. |

Idle Control Valve Harness Connector EN17




ECM Harness Connector EN01




FE02-5106b

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect idle speed control valve wiring harness connector EN17.
(c) Disconnect ECM harness connector EN01.
(d) Measure resistance between idle speed control valve wiring harness connector EN17 terminal D and ECM harness connector EN01 terminal No.36. The standard value parameter is in the table below.
(e) Measure resistance between idle speed control valve wiring harness connector EN17 terminal D and a reliable ground. The standard value parameter is in the table below.
(f) Measure voltage between idle speed control valve wiring harness connector EN17 terminal D and a reliable ground. The standard value parameter is in the table below.

| Test Items | Standard Value |
|---|---|
| Resistance Between EN17 (D) and EN01 (36) | Less than 1 Ω |
| Resistance Between EN17 (D) and a Reliable Ground | 10 kΩ or higher |
| Voltage Between EN17 (D) and a Reliable Ground | 0 V |

Are the values specified values?

No → Repair or replace the wiring harness connector. Go to step 10

Yes

| | |
|---|---|
| Step 8 | Check ECM power supply circuit. |

(a) Check whether ECM power supply circuit is normal.
(b) Check whether ECM ground circuit is normal.

No → Repair the faulty part.

Yes

| | |
|---|---|
| Step 9 | Replace ECM. |

Next

| | |
|---|---|
| Step 10 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 10 min.

(f) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 11 | Diagnostic completed. |

5. Repair Instructions:

Replace idle speed control valve. Refer to 2.2.8.1 Idle Air Control Valve Replacement.

## 2.2.7.37 DTC P0560 P0562 P0563

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0560 | System Battery Voltage Signal Unreasonable |

| | | |
|---|---|---|
| DTC | P0562 | System Battery Voltage Too Low |

| | | |
|---|---|---|
| DTC | P05673 | System Battery Voltage Too High |

ECM power supply circuit consists of the following:

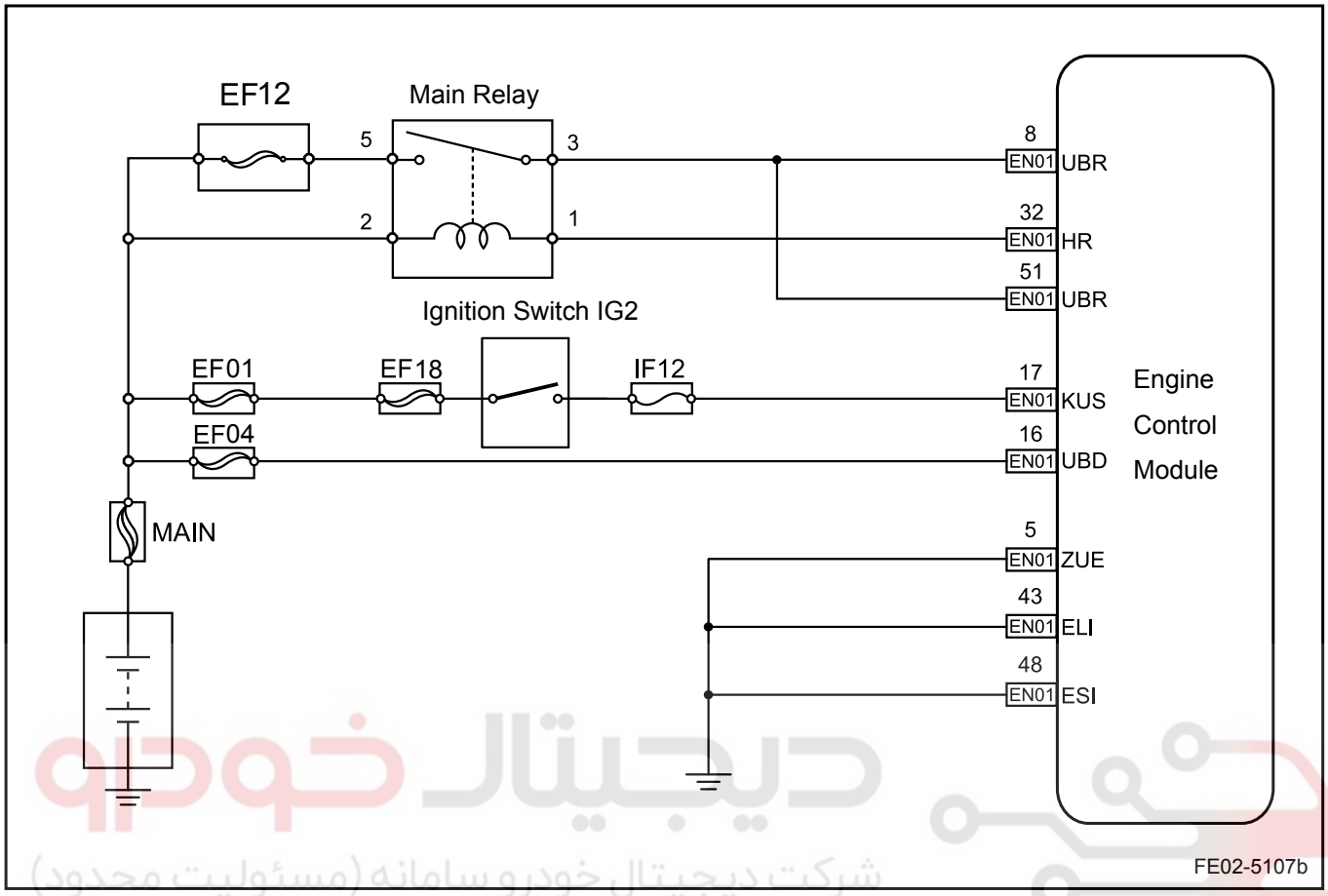
- Battery power passes through ECM KAPWR fuse 10 A to ECM harness connector EN01 terminal No.16.
- When the ignition switch is turned to "ON" position, battery power passes through the ignition switch wiring harness connector IP23 terminal No.6, to ECM fuse 10 A and finally to ECM harness connector EN01 terminal No.17.
- When ECM detects that ECM harness connector EN01 terminal No.17 has battery voltage, ECM controls EN01 terminal No.32 connected to internal ground. Because EN01 terminal No.32 is connected to the main relay terminal No.1, the main relay pulls in.

After the main relay pulls in, the battery power passes through the main relay terminal No.3 to ECM harness connector EN01 terminals No.8 and 51.

2. Conditions For Setting DTC and The Fault Location:

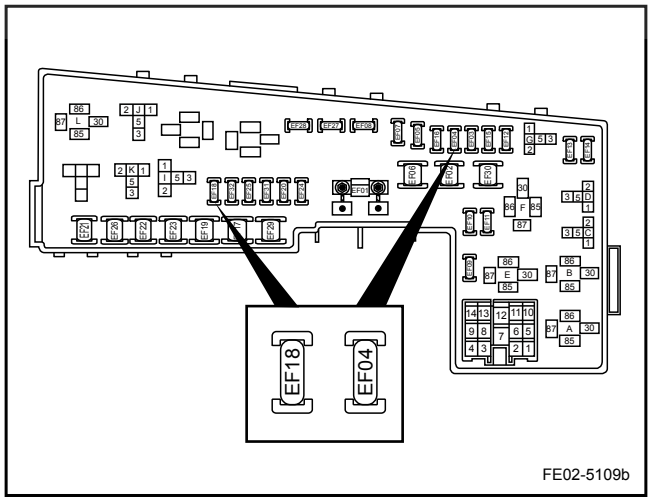
| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0560 | System check | Battery voltage is lower than 2.5 V. | 1. ECM Power Supply Circuit<br>2. Generator<br>3. ECM |
| P0562 | Lower Than the Lower Limit | 1. Battery voltage is lower than 10.02 V.<br>2. Start time is longer than 180 s. | |
| P0563 | Battery Voltage ADC Value | 1. Battery voltage is higher than 17.02 V.<br>2. Vehicle speed is greater than 25 km/h.<br>3. Start time is longer than 180 s. | |

3. Schematic:




4. Diagnostic Steps:

| | |
|---|---|
| Step 1 | Check ECM fuses EF04 and EF18. |



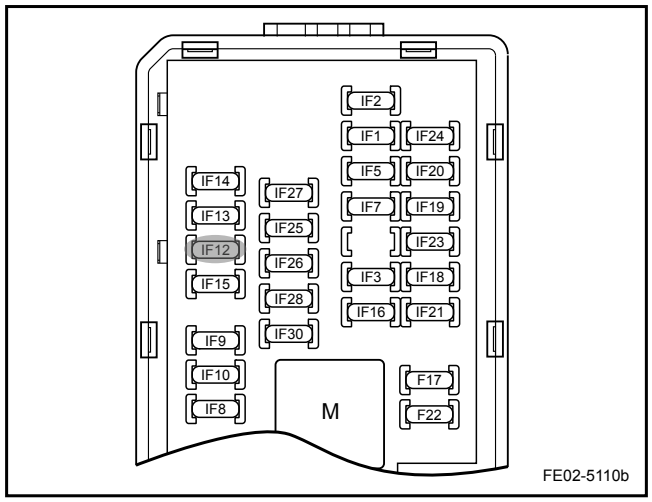

(a) Turn the ignition switch to "OFF" position.
(b) Remove fuses EF04, EF18 from the I/P fuse block.
(c) Use multimeter to measure whether there is conduction between the two terminals.

Conducted?

No → Check whether there are short circuits. Replace the fuses.

Yes

| | |
|---|---|
| Step 2 | Check I/P fuse block ECM fuse IF12. |




(a) Turn the ignition switch to "OFF" position.
(b) Remove IF12 from the I/P fuse block.
(c) Use multimeter to measure whether there is conduction between the two terminals.

Conducted?

No → Check whether there are short circuits. Replace the fuses.

Yes

| Step 3 | Check ECM power supply voltage. |
|---|---|

ECM Harness Connector EN01


(a) Turn the ignition switch to "OFF" position.
(b) Disconnect ECM harness connector EN01.
(c) Turn the ignition switch to "ON" position.
(d) Measure voltage between ECM harness connector EN01 terminal No.16 and a reliable ground.
(e) Measure voltage between ECM harness connector EN01 terminal No.17 and a reliable ground.

Standard Voltage: 11-14 V

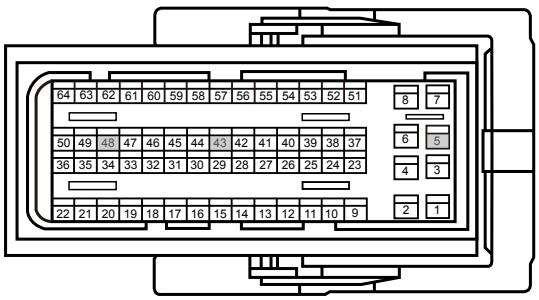
Voltage normal?

No → Go to step 5

Yes

| Step 4 | Check ECM ground circuit. |
|---|---|

ECM Harness Connector EN01




(a) Turn the ignition switch to "OFF" position.
(b) Disconnect ECM harness connector EN01.
(c) Measure resistance between ECM harness connector EN01 terminal No.5 and a reliable ground.
(d) Measure resistance between ECM harness connector EN01 terminal No.43 and a reliable ground.
(e) Measure resistance between ECM harness connector EN01 terminal No.48 and a reliable ground.

Standard Resistance: Less than 1 Ω

Resistance normal?

No → ECM ground circuit is faulty. Repair the faulty part.

Yes

| Step 5 | Check charging system. |
|---|---|

(a) Check the battery voltage.
Standard Voltage: 11-14 V

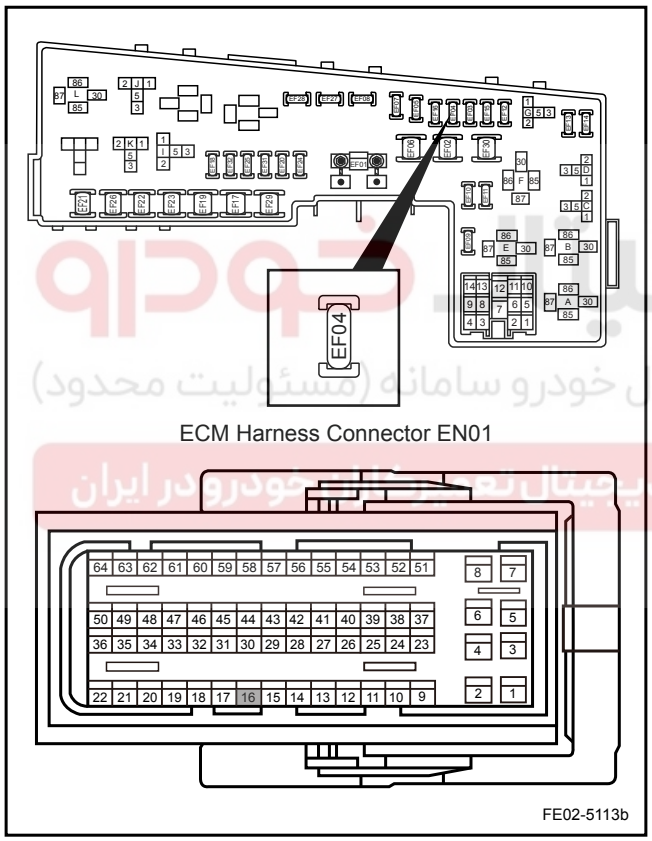
(b) Check the generator charging voltage.
Standard Resistance: 11.5-14.5 V

Normal?

No → Repair the faulty part.

Yes → Go to step 8

| Step 6 | Check EF04 fuse to ECM circuit. |
|---|---|




ECM Harness Connector EN01

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect ECM harness connector EN01.
(c) Measure continuity between ECM harness connector EN01 terminal No.16 and the fuse No.EF04.
(d) Measure resistance between ECM harness connector EN01 terminal No.16 and A reliable ground.

Standard Value:

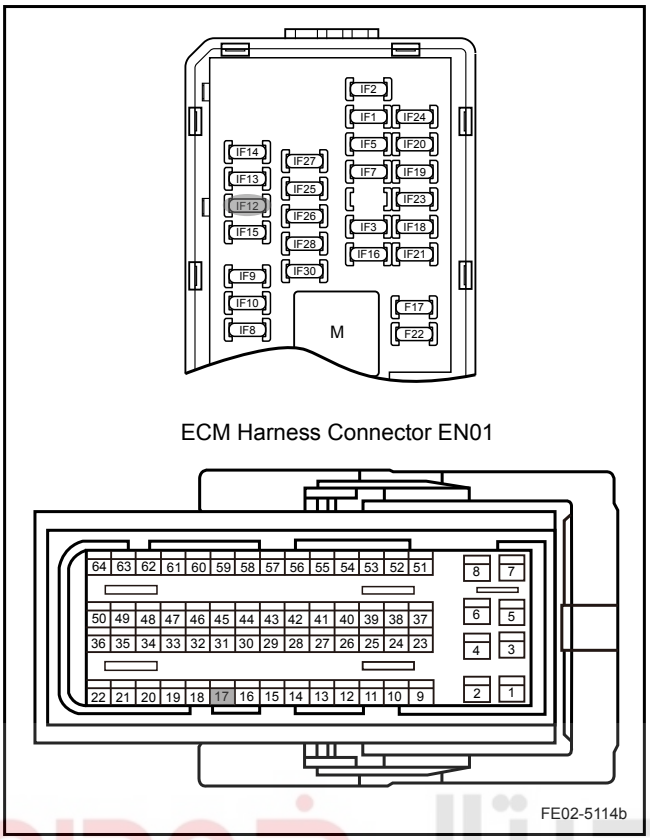
| Test Items | Specified Value |
|---|---|
| Continuity Between EN01 (16) and EF04 | Conducted |
| Resistance Between EN01 (16) and a Reliable Ground | 10 kΩ or higher |

Normal?

No → The wiring harness is faulty. Repair or replace the wiring harness.

Yes

| Step 7 | Check circuit between fuse IF12 and ECM. |
|---|---|




ECM Harness Connector EN01

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect ECM harness connector EN01.
(c) Measure continuity between ECM harness connector EN01 terminal No.17 and fuse IF12.
(d) Measure resistance between ECM harness connector EN01 terminal No.17 and A reliable ground.

Standard Value:

| Test Items | specified value |
|---|---|
| Continuity Between EN01 (17) and IF12 | turn |
| Resistance Between EN01 (17) and a Reliable Ground | 10 kΩ or higher |

Normal?

No → The wiring harness is faulty. Repair or replace the wiring harness.

Yes

| | |
|---|---|
| Step 8 | Use scan tool to confirm whether the DTC code is stored again. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Clear DTC code.
(d) Start and run the engine at idle speed to warm up the engine for at least 5 min.
(e) Road test the vehicle for at least 10 min.
(f) Read control system DTC code again to confirm that the system has no DTC code.

No → Intermittent Fault. Refer to 2.2.7.3 Intermittent Fault Check

Yes

| | |
|---|---|
| Step 9 | Replace ECM. |

## 2.2.7.38 DTC P0602

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0602 | Electronic Control Module DTC Codes Error |

ECM Internal Process Errors

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0602 | ECM Internal Monitoring | --- | ECM |

4. Diagnostic Steps:

| | |
|---|---|
| Step 1 | Check whether there is control system DTC code other than DTC P0602. |

(a) Connect scan tool to the datalink connector.
(b) Turn the ignition switch to "ON" position.
(c) Press the scan tool power button.
(d) Select the following menu items: Engine/Read DTC codes.
(e) Read DTC codes.

Results:

| DTC Codes Shown | To Step |
|---|---|
| DTC P0602 | Yes |
| DTC Codes Other Than DTC P0602 | No |

No → Refer to 2.2.7.11 DTC Code Index

Yes

| | |
|---|---|
| Step 2 | Replace ECM. |



## 2.2.7.39 DTC P0627 P0628 P0629

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0627 | Fuel Pump Relay Control Circuit Open |
| DTC | P0628 | Fuel Pump Relay Control Circuit Short to Ground |
| DTC | P0629 | Fuel Pump Relay Control Circuit Short to Power Supply |

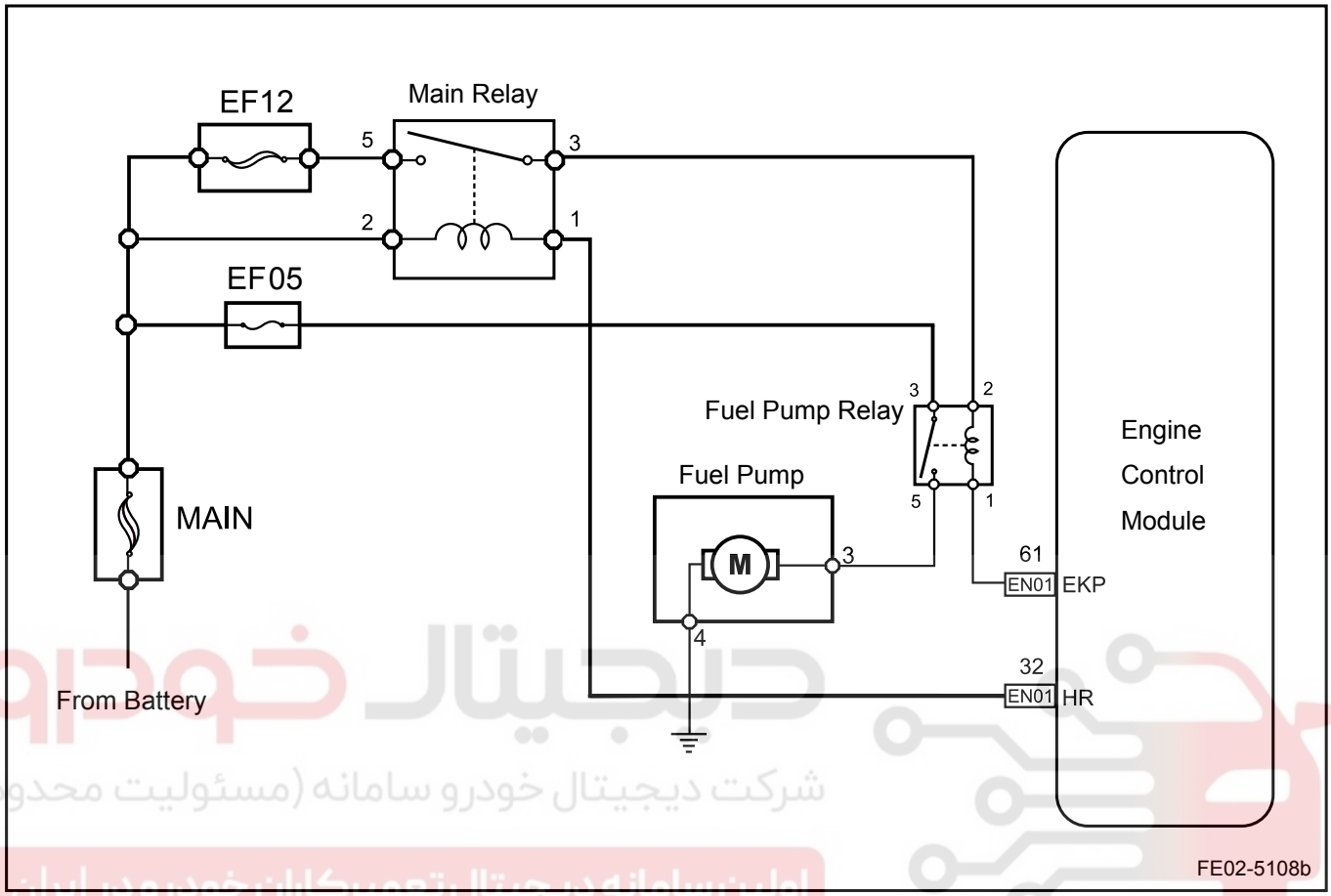
Fuel pump relay coil power is provided by the main relay under the control of ECM. ECM controls pump relay terminal No.1 to the internal ground by ECM harness connector EN01 terminal No.61 and so the fuel pump relay pulls in. ECM has an internal driver circuit that controls relay coil ground. The driver circuit is equipped with a feedback circuit to ECM. ECM monitors the feedback voltage control circuit to determine whether the there is an open circuit, a circuit short to ground or power supply.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0627 | Hardware Circuit Checks | Circuit Open. | 1. Relay Circuit |
| P0628 | | Circuit Short to Ground. | 2. Relay<br>3. ECM |

| | | | |
|---|---|---|---|
| P0629 | | Circuit Short to Power Supply. | |

3. Schematic:




4. Diagnostic Steps:

Check fuel pump relay circuit. Refer to 2.3.7.3 Fuel Pump Inoperative.

## 2.2.7.40 DTC P0645-P0647

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0645 | A/C Compressor Relay Control Circuit Open |
| DTC | P0646 | A/C Compressor Relay Control Circuit Short to Ground |
| DTC | P0647 | A/C Compressor Relay Control Circuit Short to Power Supply |

The Air-Conditioning compressor relay working voltage is provided by the main relay controlled by ECM. ECM controls air-conditioning compressor relay internal ground by ECM harness connector EN01 terminal No.60, so relay pulls in. ECM has a driver circuit that controls relay coil ground. The driver circuit is equipped with a feedback circuit to ECM. ECM monitors the feedback voltage control circuit to determine whether the there is an open circuit or a circuit short to ground or power supply.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0645<br>P0646<br>P0647 | Hardware Circuit Checks | 1. Circuit Open.<br>2. Circuit Short to Ground.<br>3. Circuit Short to Power Supply. | 1. Air-Conditioning Relay<br>2. ECM |

3. Schematic:

Refer to 8.2.6.2 Air-conditioning System Circuit Schematic.

4. Diagnostic Steps:

Refer to 8.2.7.6 Air-conditioning Clutch Inoperative.

## 2.2.7.41 DTC P0650

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P0650 | MIL Lamp Driver Malfunction |

CAN network is used in vehicles. Fault lamps are controlled via the instrument panel circuit. When ECM DTC code is set to light fault lamps, ECM sends a "Light the fault lamp" signal through the CAN network the instrument panel. The instrument panel internal circuit light the fault lamp indicating engine fault after receiving the instruction from ECM.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P0650 | Hardware Circuit Checks | 1. Circuit Open.<br>2. Circuit Short to Ground.<br>3. Circuit Short to Power Supply. | 1. Instrument Panel<br>2. CAN Bus |

3. Diagnostic Steps:

Refer to 2.2.7.44 Engine Fault Lamp (MIL)/Check Vehicle Lamp Malfunction.

## 2.2.7.42 DTC P1610-P1614

1. DTC Descriptor:

| | | |
|---|---|---|
| DTC | P1610 | Anti-theft Malfunction |
| DTC | P1611 | Anti-theft Malfunction |
| DTC | P1612 | Anti-theft Malfunction |
| DTC | P1613 | Anti-theft Malfunction |

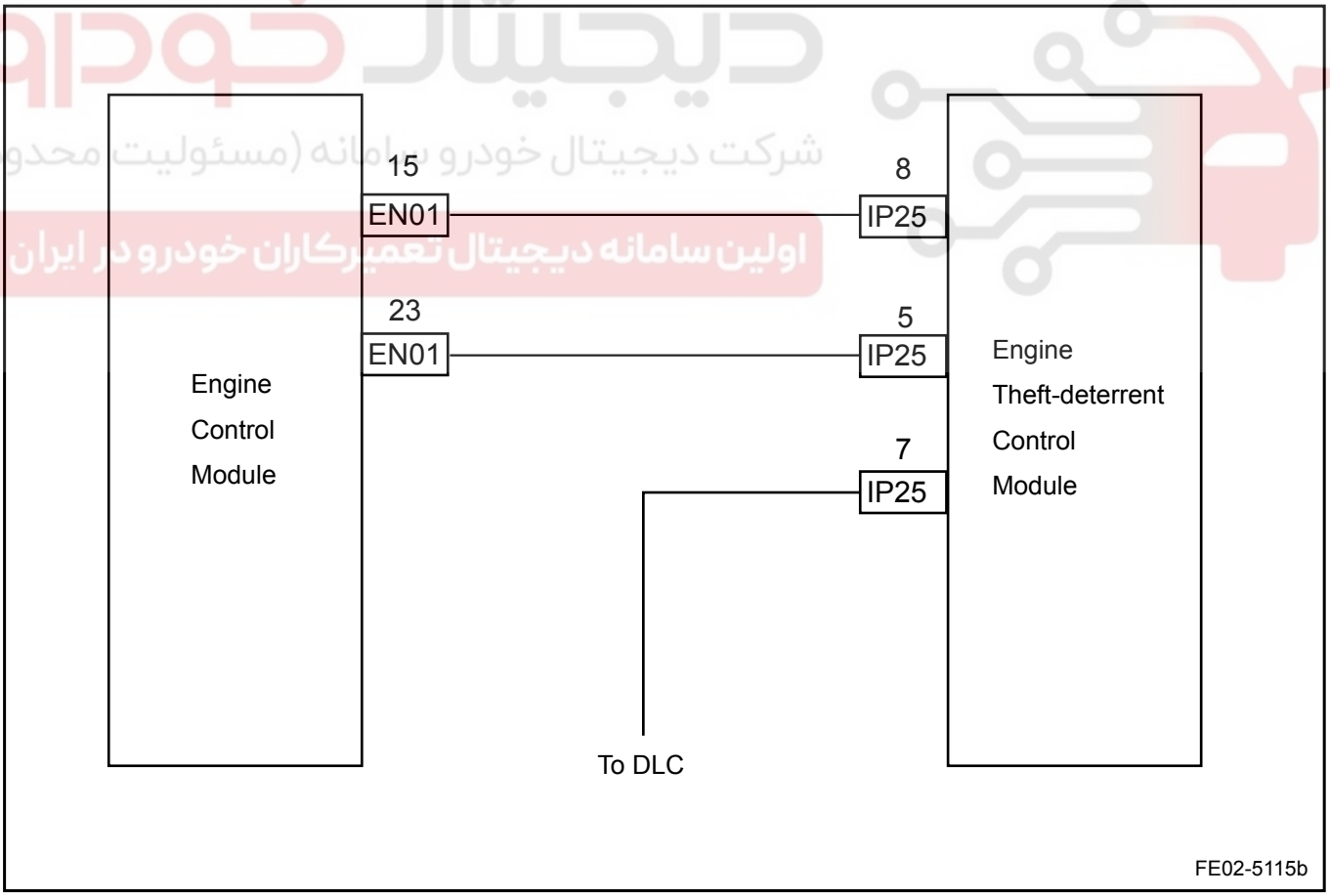
| DTC | P1614 | Anti-theft Malfunction |
|---|---|---|

ECM communicates with the anti-theft control module via ECM harness connector EN01 terminal No.15 W-LIN and terminal No.23 R-LIN-line. For working details. Refer to.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P1610 | Security keys and security codes are not programmed. | Turn the ignition switch to "ON". | 1. Ignition Key<br>2. Ignition Key Coil<br>3. ECM<br>4. Chip Anti-theft Module<br>5. Data circuit (W-LIN circuit, R-LIN-line) |
| P1611 | Security Code Error | | |
| P1612 | Security Request Not Accepted | | |
| P1613 | Security Code Request Services Not Accepted | | |
| P1614 | Anti-theft Transceiver Fails to Respond, Damaged or Malfunction | | |

3. Schematic:




4. Diagnostic Steps:

Refer to 2.5.7.12 Engine Anti-theft Warning Lamp Flashing, Vehicle Can Not Start.

5. Repair Instructions:

Repair the anti-theft system. Refer to2.5.7 Diagnostic Information and Procedures.

## 2.2.7.43 DTC P1523 U0001 U0121 U0140 U0151

1. DTC Descriptor:

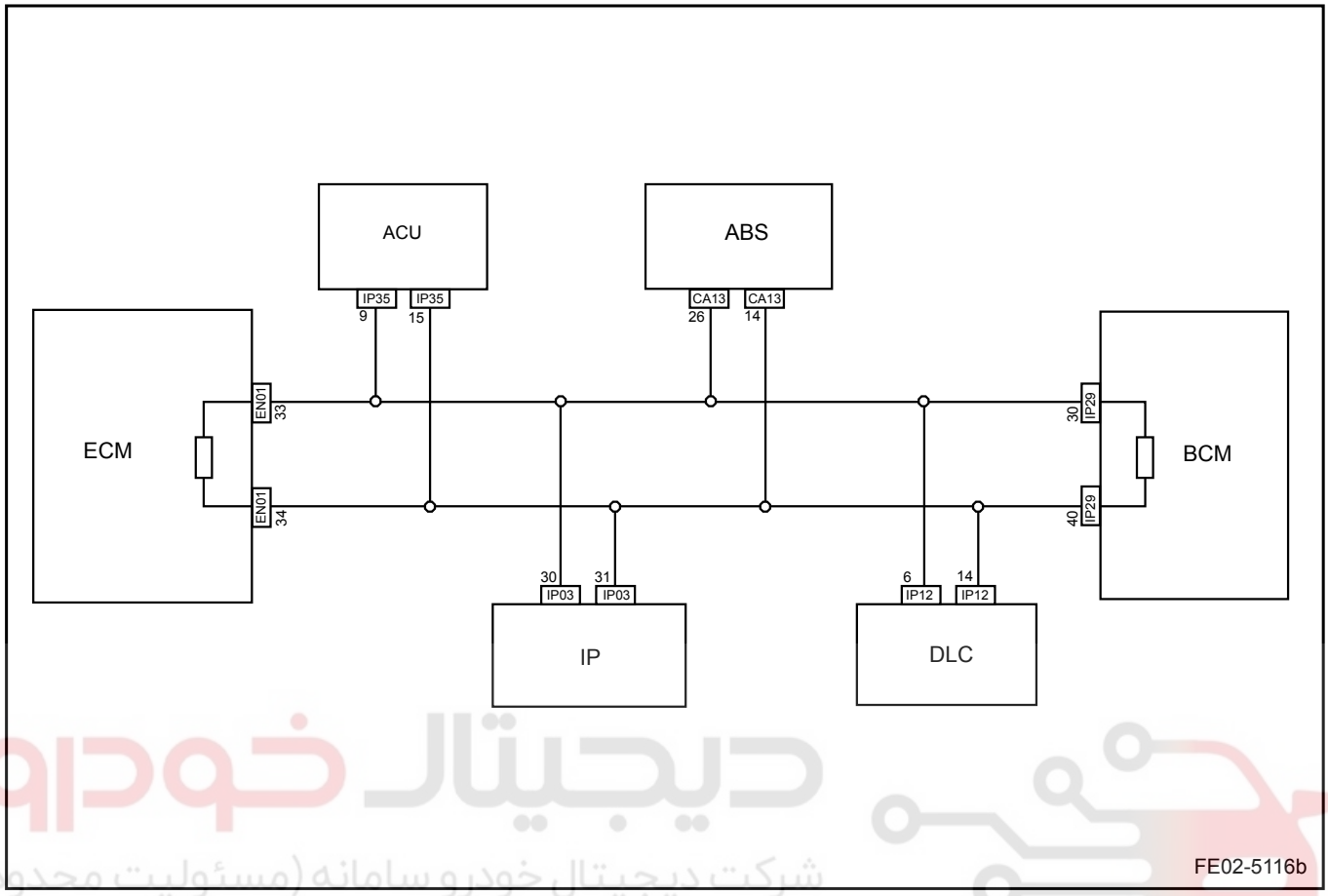
| | | |
|---|---|---|
| DTC | P1523 | airbag control module to ECU Signals Interrupted or Incorrect |
| DTC | U0001 | CAN High-Speed Line Fault |
| DTC | U0121 | Communications with ABS Controller Interrupted |
| DTC | U0140 | Communications with BCM Controller Interrupted |
| DTC | U0151 | Communications with airbag control module Controller Interrupted |

In this vehicle, anti-lock brake system control module, airbag control module, body control module, engine control module and the instrument cluster are connected to the CAN bus, consisting a linear connection. The terminal resistors are set within the BCM and ECM.

2. Conditions For Setting DTC and The Fault Location:

| DTC Code | DTC Detection Strategy | Conditions For Setting The DTC (Control Strategy) | Fault Locations |
|---|---|---|---|
| P1523<br>U0001<br>U0121<br>U0140<br>U0151 | Hardware Circuit Checks | Communication signal loss, signal logic error. | 1. Airbag control module, BCM (Body Control Module), ECM (Engine Control Module)<br>2. CAN Bus |

3. Schematic:




4. Diagnostic Steps:

Refer to 11.17.7.6 CAN Bus Signal Diagnostic.

## 2.2.7.44 Engine Fault Lamp (MIL)/Check Vehicle Lamp Malfunction

Description:

CAN network is used in vehicles. Fault lamps are controlled via the instrument panel circuit. When ECM DTC code is set to light fault lamps, ECM sends a "Light the fault lamp" signal through the CAN network the instrument panel. The instrument panel internal circuit light the fault lamp indicating engine fault after receiving the instruction from ECM.

Diagnostic Steps:

| | |
|---|---|
| Step 1 | Check other fault lamps in the instrument cluster. |

(a) Turn the ignition switch to "ON" position.

Other fault lamps normal?

Yes → Go to step 3

No

| | |
|---|---|
| Step 2 | Repair instrument cluster circuits. |

(a) Repair instrument cluster power supply circuit. Refer to 11.7.6.7 DTC U129C U129D.

(b) Repair instrument cluster ground circuit. Refer to 11.7.6.7 DTC U129C U129D.

Fault solved?

Yes → System normal

No

| | |
|---|---|
| Step 3 | Check the instrument DTC codes. |

(a) Connect scan tool.
(b) Turn the ignition switch to "ON" position.
(c) Scan instrument DTC.

Is there DTC U1430?

Yes → Go to step 5

No

| | |
|---|---|
| Step 4 | Test the fault indicator lamp. |

(a) Connect scan tool.
(b) Turn the ignition switch to "ON" position.
(c) Select on the scan tool "Fault indicator lamp test" menu within the "Function Test".

Is the fault indicator lamp lit?

Yes → Go to step 6

No

| | |
|---|---|
| Step 5 | Replace the instrument cluster. |

(a) Turn off the ignition switch and remove the ignition key.
(b) Disconnect the battery negative cable.
(c) Replace the instrument cluster. Refer to 11.7.7.1 Instrument Cluster Replacement.

Fault solved?

Yes → System normal

No

| | |
|---|---|
| Step 6 | Repair the instrument cluster and ECM network communication. |

(a) Repair the instrument cluster and ECM network communication. Refer to 11.17.7.4 CAN Bus Integrity Diagnosis.

Fault solved?

Yes → System normal

No

| | |
|---|---|
| Step 7 | Repair ECM power supply circuit. |

(a) Repair ECM power supply circuit. Refer to 2.2.7.37 DTC P0560 P0562 P0563.

Fault solved?

Yes → System normal

No

| | |
|---|---|
| Step 8 | Replace ECM. |

(a) Connect scan tool.
(b) Turn the ignition switch to "ON" position.
(c) Scan ECM DTC codes, identify ECM fault. If necessary, Replace ECM. Refer to 2.2.8.8 Engine Control Module Replacement.
(d) Clear DTC code.

Next

| | |
|---|---|
| Step 9 | System normal. |

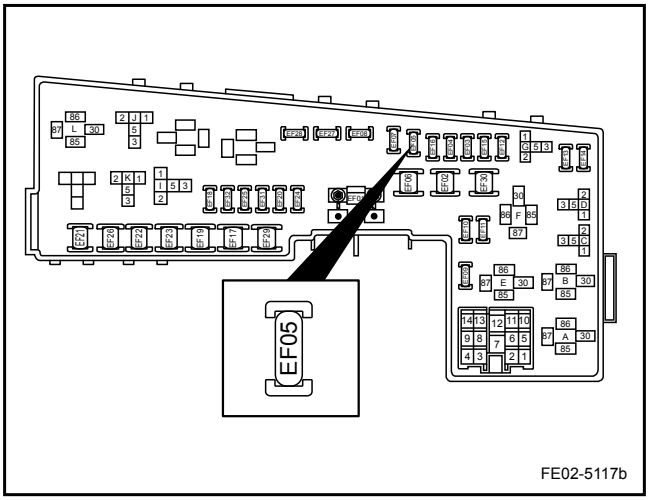
## 2.2.7.45 Crankshaft rotates, but the engine can not start.

Note

Before carry out this step, make sure the engine oil is comply with the manufacturer requirements, the fuel tank has sufficient fuel and battery has enough power for starting engine. Observe the scan tool data list, analyze the accuracy of the data, as these will facilitate diagnostic.

Diagnostic Steps:

| | |
|---|---|
| Step 1 | Check fuel pump fuse. |




(a) Check whether the fuel pump fuse is faulty.
(b) Repair fuel pump fuse power circuit.
(c) If necessary, replace the faulty fuel pump fuse.

Fault solved?

Yes → System normal

No

| | |
|---|---|
| Step 2 | Scan ECM for DTC codes. |

(a) Connect scan tool.
(b) Turn the ignition switch to "ON" position.
(c) Scan ECM for DTC codes.
(d) Check DTC P0627 and any fuel system related DTC codes and repair the faulty part. Refer to 2.2.7.11 DTC Code Index.
(e) Clear ECM DTC codes.

Start the engine, fault solved?

Yes → System normal

No

| | |
|---|---|
| Step 3 | Check fuel pump relay. |

(a) Connect scan tool.
(b) Turn the ignition switch to "ON" position.
(c) Select scan tool "Fuel Pump Relay" in the "Action Test" to drive the fuel pump relay.

Is fuel pump relay working properly?

Yes → Go to step 6

No

| | |
|---|---|
| Step 4 | Replace the fuel pump relay. |

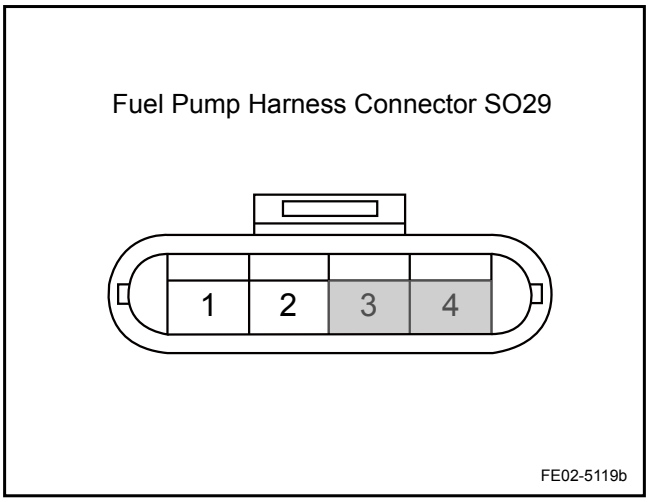
(a) Refer to "Fuel System" in the 2.3.7.3 Fuel Pump Inoperative.
(b) Replace the fuel pump relay.
(c) Inspect fuel pump relay circuits and repair the faulty part.

Start the engine, fault solved?

Yes → System normal

No

| | |
|---|---|
| Step 5 | Check the fuel pump circuit. |



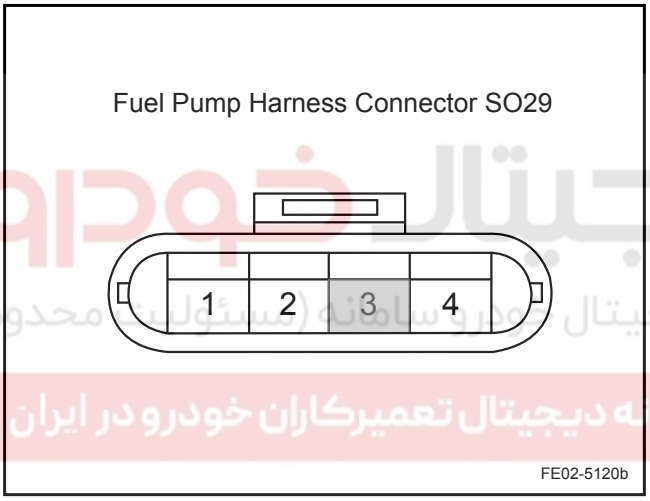

(a) Turn the ignition switch to "OFF" position.
(b) Disconnect fuel pump harness connector SO29.
(c) Connect scan tool.
(d) Turn the ignition switch to "ON" position.
(e) Select scan tool "Fuel Pump Relay" in the "Action Test" to drive the fuel pump relay.
(f) Connect SO29 terminal 3 and 4 with a test lamp.

Is test lamp lit properly?

Yes → Go to step 8

No

| | |
|---|---|
| Step 6 | Repair the fuel pump circuit. |




(a) Turn the ignition switch to "ON" position.
(b) Check the fuel pump working circuits. Repair the fuel pump relay open circuit fault between SO29 terminal No.3 and No. 5.

Start the engine, fault solved?

Yes → System normal

No

| | |
|---|---|
| Step 7 | Check the fuel pressure. |

(a) Turn the ignition switch to "OFF" position.
(b) Install fuel pressure gage and connect scan tool.
(c) Turn the ignition switch to "ON" position.
(d) On the scan tool, select scan tool "Fuel Pump Relay" in the "Action Test" to drive the fuel pump relay.

Standard Fuel Pressure Value: 400 kPa

Is fuel pressure normal?

Yes → Go to step 9

No

| | |
|---|---|
| Step 8 | Replace the fuel pump. |

(a) Turn off the ignition switch and remove the ignition key.

(b) Replace fuel pump assembly. Refer to 2.3.8.3 Fuel Pump Assembly Replacement.

Start the engine, fault solved?

Yes → System normal

No

| | |
|---|---|
| Step 9 | Inspect (repair) fuel injectors. |

(a) Inspect (repair) fuel injectors. Refer to the DTC code2.2.7.24 DTC P0201 P0261 P0262in the repair procedures. If necessary, replace the faulty fuel injectors.

Start the engine, fault solved?

Yes → System normal

No

| | |
|---|---|
| Step 10 | Check the ignition coil. |

(a) Turn the ignition switch to "OFF" position.

(b) Remove the cylinder ignition wire. Connect a new wire connect the spark plug to a reliable ground.

(c) Remove the fuel pump fuse.

(d) Start the engine.

Is spark plug ignition normal?

Yes → Go to step 13

No

| | |
|---|---|
| Step 11 | Replace the ignition coil. |

(a) Turn off the ignition switch and remove the ignition key.

(b) Replace the ignition coil. Refer to 2.10.8.3 Ignition Coil Replacement.

Start the engine, fault solved?

Yes → System normal

No

| | |
|---|---|
| Step 12 | Check crankshaft position sensor and circuit. |

(a) Check crankshaft position sensor. Refer to 2.2.7.29 DTC P0321 P0322.

(b) Measure the crankshaft position sensor resistance with a multimeter.

Standard Resistance: 870 Ω

(c) Inspect the sensor circuit. Repair the faulty part. If necessary, replace the crankshaft position sensor. Refer to 2.10.8.2 Crankshaft Position Sensor Replacement.

Start the engine, fault solved?

Yes → System normal

No

| | |
|---|---|
| Step 13 | Test the cylinder pressure. |

(a) Test the cylinder pressure. Refer to the "Engine Mechanical System" in the.

Standard Cylinder Pressure: 800 kPa

All cylinders compression pressure equal to or higher than the specified value?

Yes → Go to step 16

No

| | |
|---|---|
| Step 14 | Timing Chain Inspection. |

(a) Turn off the ignition switch and remove the ignition key.
(b) For timing chain inspection. Refer to "Engine Mechanical System" in the2.6.8.11 Timing Chain Inspection.

Is timing chain positioned properly?

Yes → Go to step 16

No

| | |
|---|---|
| Step 15 | Install the timing chain. |

(a) Turn off the ignition switch and remove the ignition key.
(b) Reinstall the timing chain. Refer to "Engine Mechanical System" in the2.6.8.10 Timing Chain Replacement.

Start the engine, fault solved?

Yes → System normal

No

| | |
|---|---|
| Step 16 | Check mechanical parts inside the engine. |

(a) Remove the engine.
(b) Check the mechanical parts inside the engine. If necessary, repair the damaged parts inside the engine.
(c) identify the damaged parts repair has been completed.

Next

| | |
|---|---|
| Step 17 | Diagnostic completed. |

## 2.2.7.46 Idle Speed Reading Procedure

Must carry out this procedure if any of the following occurs:

- Disconnect battery cables.

- Engine control module is disconnected or replaced.
- The fuse between the ignition voltage IGN1 or battery positive voltage and the engine control module is removed.
- The idle air control valve has been removed or replaced.
- idle air control system malfunction.

Read in procedure:

| | |
|---|---|
| Step 1 | Run the engine until the engine coolant temperature exceeds 90°C(194 ºF). |

Next

| | |
|---|---|
| Step 2 | Run the engine at idle speed for 5min. |

Next

| | |
|---|---|
| Step 3 | Turn off the ignition switch. |

Next

| | |
|---|---|
| Step 4 | Read in procedure completed. Restart the engine and confirm that the engine idle speed is normal. |

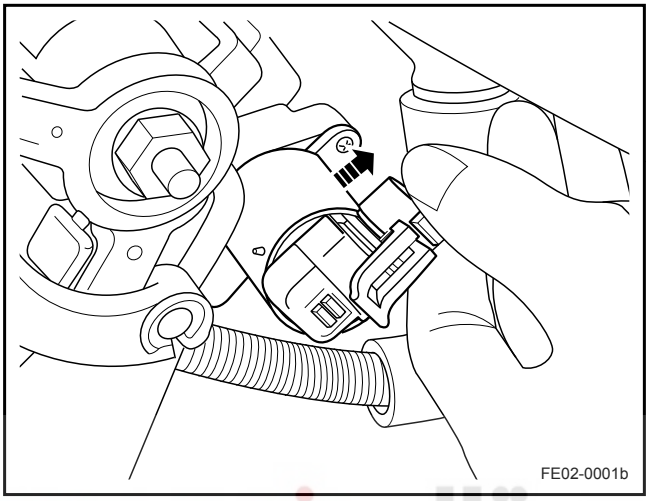
## 2.2.8 Removal and Installation

### 2.2.8.1 Idle Air Control Valve Replacement

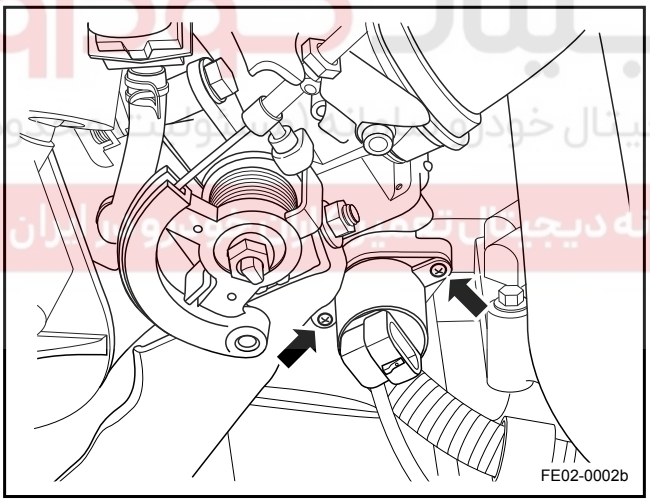
Removal Procedure:

Note

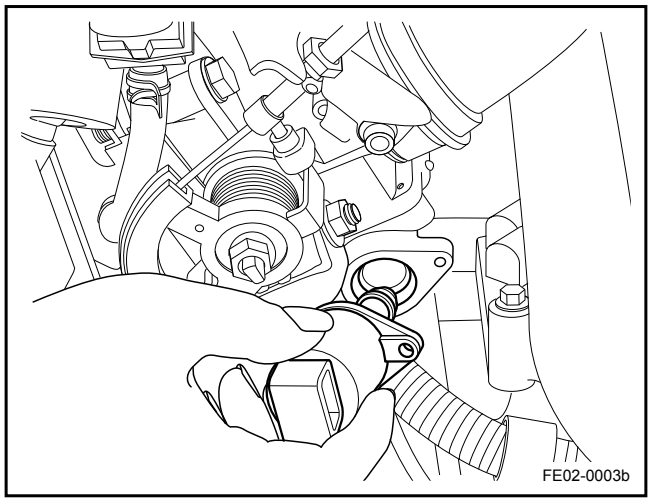
Refer to "Battery Disconnection Warning" in the "Warnings and Notices".




1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Disconnect idle speed control valve wiring harness connector.




3. Remove the idle speed control valve retaining bolts from the throttle body.

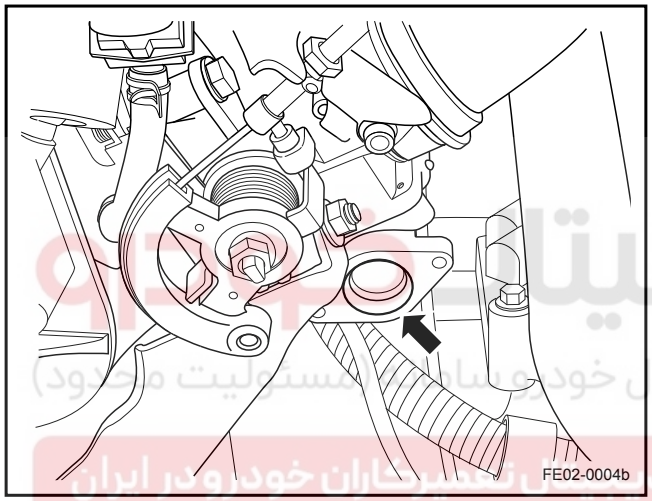



4. Remove the idle speed control valve from the throttle body.

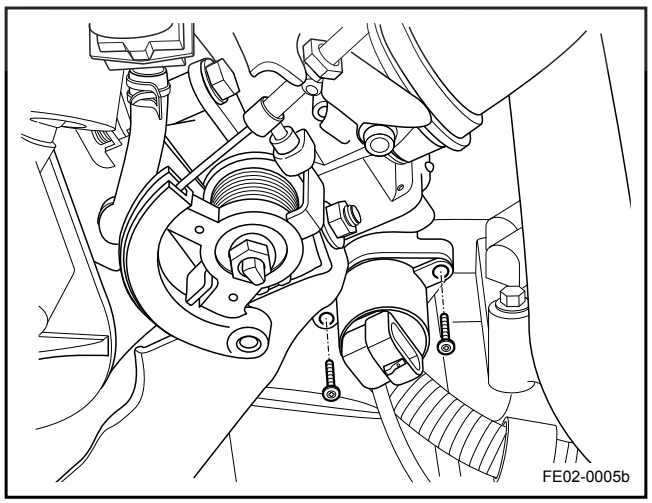
Note

Do not drop the idle speed control valve O-ring.

Installation Procedure:




1. Clean carbon residue in the throttle body idle speed control valve air bypass.

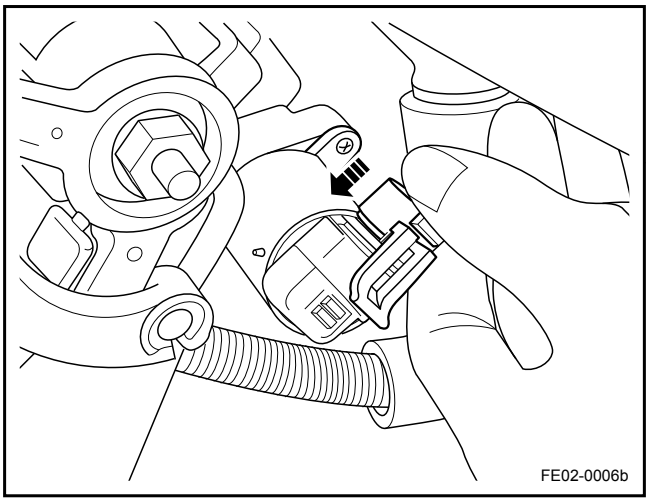



2. Install and tighten idle speed control valve retaining bolts.

Note

Check the idle speed control valve O-ring is installed in good conditions.

Torque: 2.5 Nm (Metric) 1.85 lb-ft (US English)



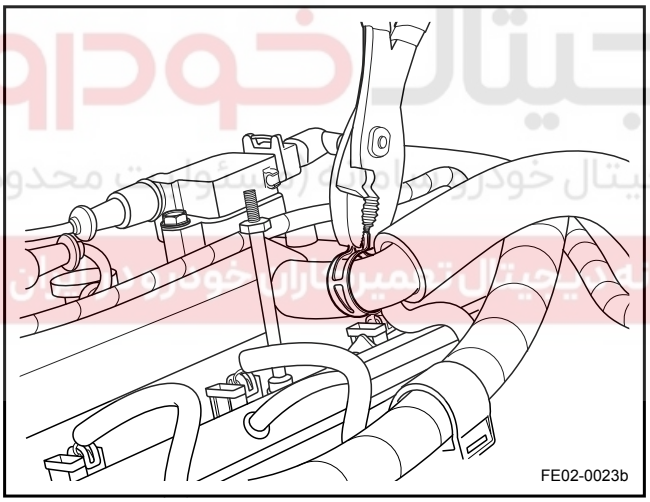

3. Connect the idle speed control valve wiring harness connector.
4. Connect the battery negative cable.

## 2.2.8.2 Fuel Injector Replacement

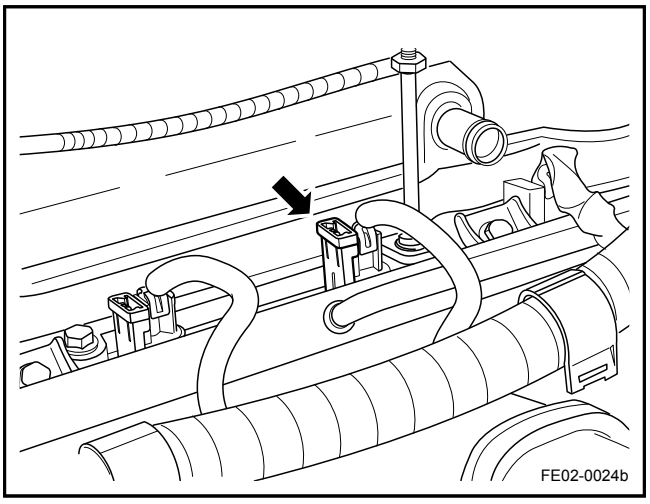
Removal Procedure:

Warning!

Refer to "Battery Disconnection Warning" in the "Warnings and Notices".



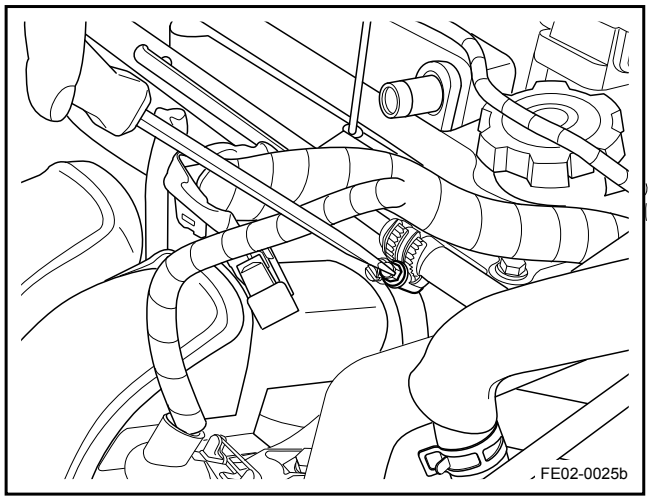

1. Release fuel system pressure. Refer to 2.3.8.1 Fuel Pressure Release Procedure.
2. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
3. Remove the hood. Refer to 2.6.8.1 Plastic Engine Shield Replacement.
4. Disconnect the crankcase ventilation tube.



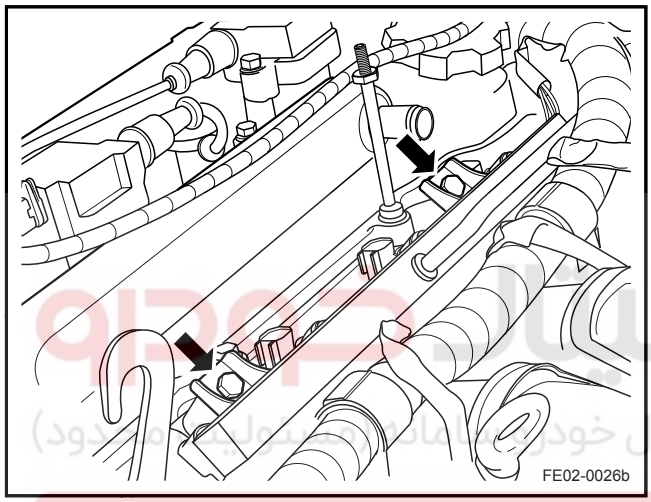

5. Disconnect the fuel injector wiring harness connector.

   Note

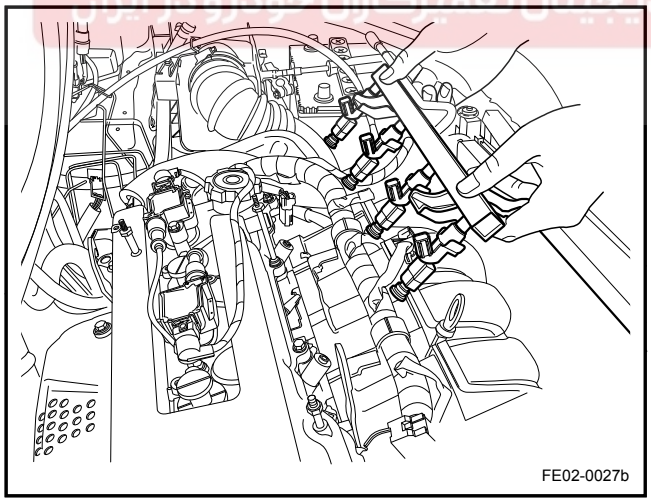
   Pull up the connector gray part of the self-locking device, and then press down to Disconnect the connector.




6. Remove the fuel pipe from the fuel rail.



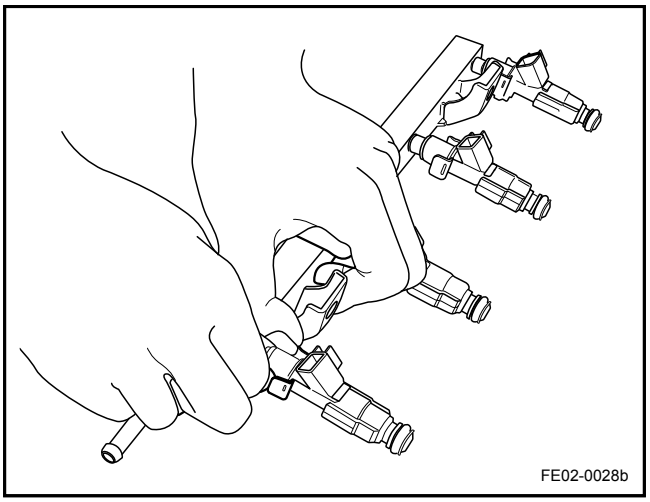

7. Remove the fuel rail retaining bolts.



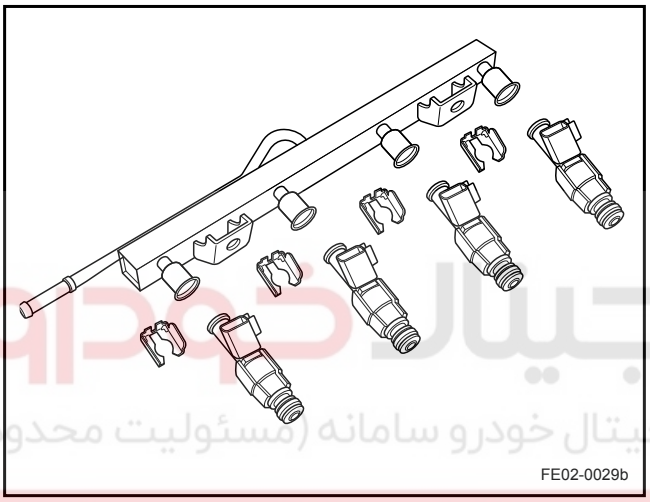

8. Remove the fuel rail and fuel injector assembly.

Note

Plug four fuel injector holes immediately after removal to prevent debris falling into the cylinder causing engine damage.


FE02-0028b

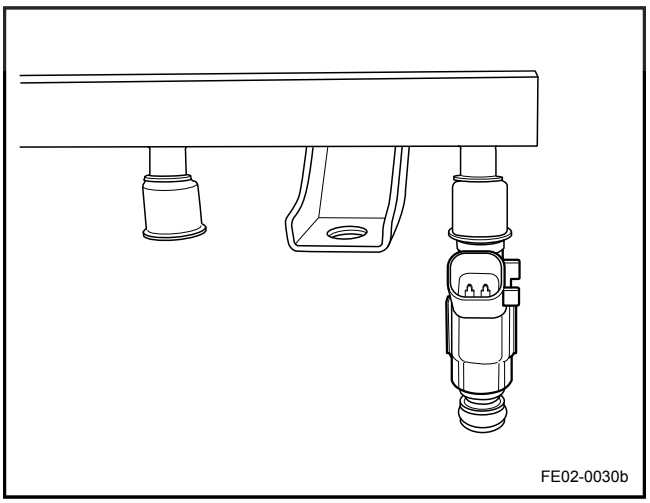
9. Remove fuel injectors retaining clips.


FE02-0029b

10. Pull fuel injectors out of the fuel rail.



Installation Procedure:

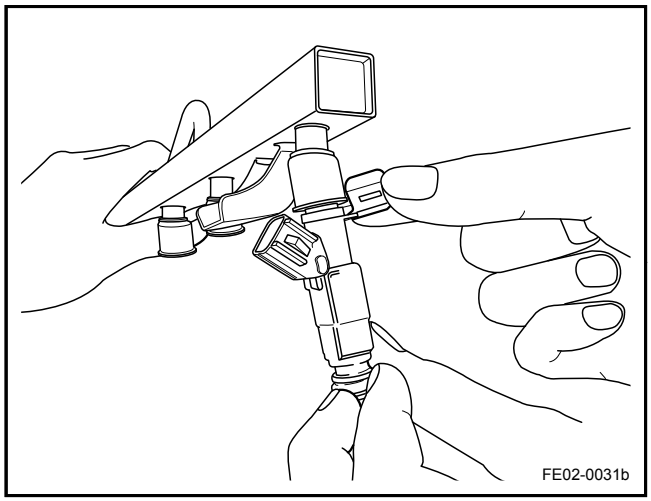

FE02-0030b

1. Apply a small amount of engine oil to lubricate the fuel injector O-ring.

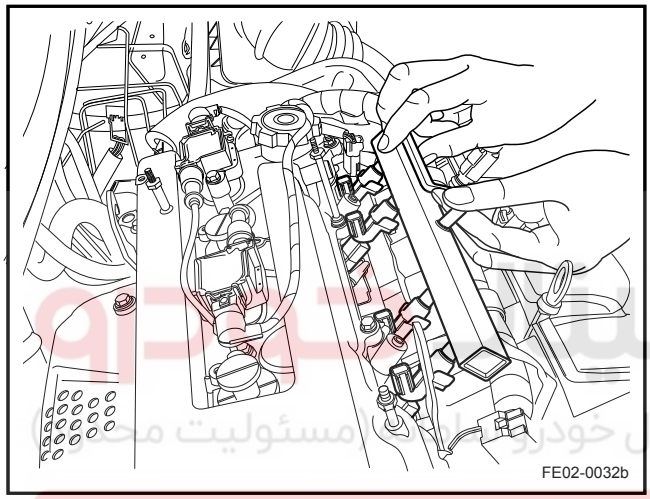
2. Install the fuel injectors to the fuel rail.

   Note

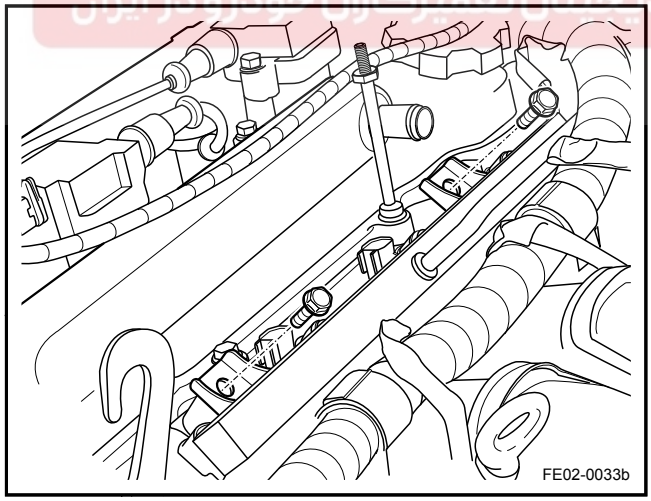
   The fuel injector terminals should face outside.




3. Install fuel injector retaining clips to ensure that the fuel injector wiring harness connector and the fuel rail mounting hole are in the same direction.

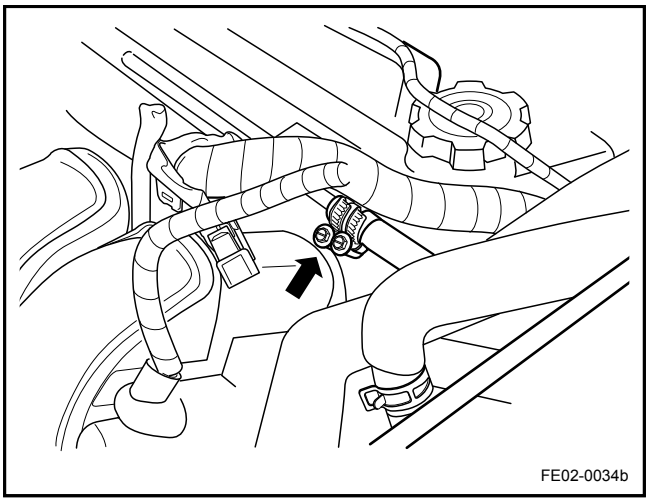



4. Install the fuel rail.




5. Install the fuel rail retaining bolts.

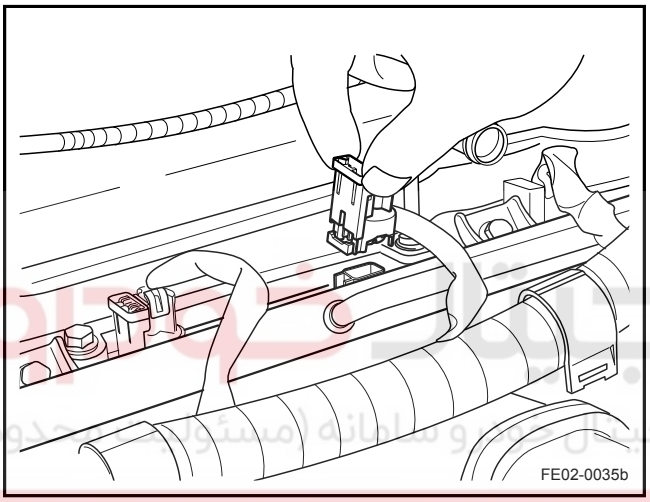
   Torque: 9 Nm (Metric) 6.66 lb-ft (US English)



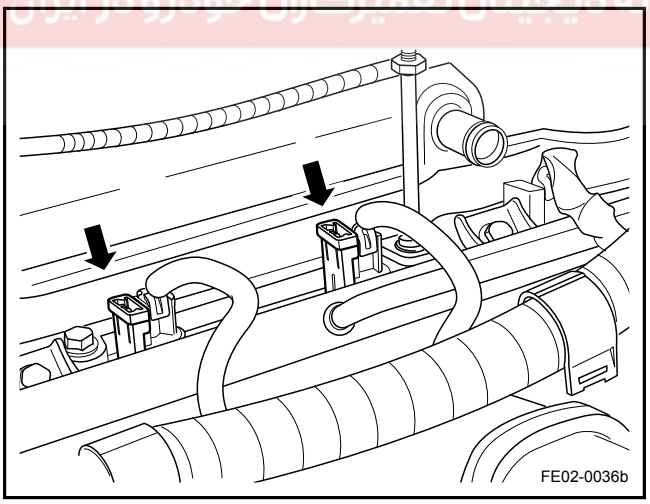

6. Connect the fuel pipe.

Note

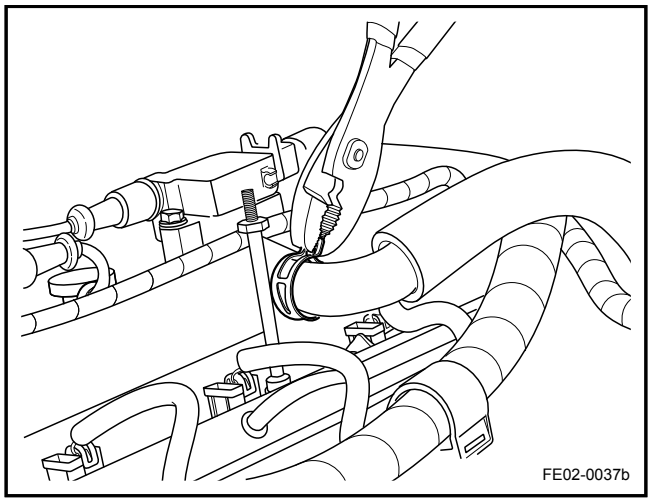
The fuel pipe must be inserted into the fuel rail after the second boss and then tightened with the clips.




7. Connect the fuel injector wiring harness connector.




8. Restore the self-locking device.




9. Install the crankcase ventilation tube.
10. Connect the battery negative cable.

    Note

    Start the engine. Check fuel and fuel injectors for fuel leaks and vacuum leaks.

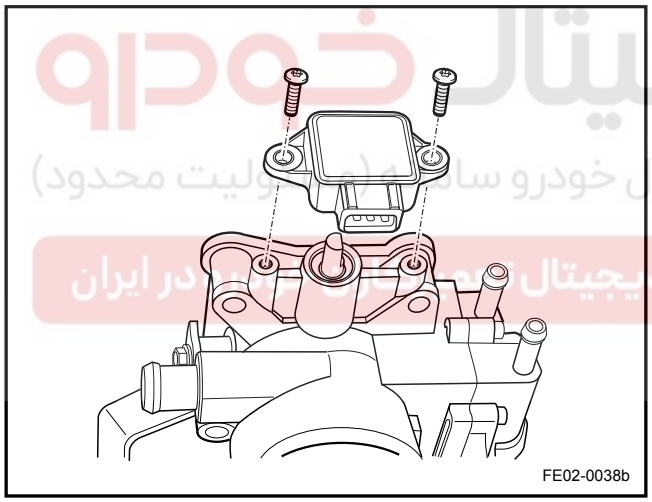
11. Install the engine hood.

## 2.2.8.3 Throttle Position Sensor Replacement

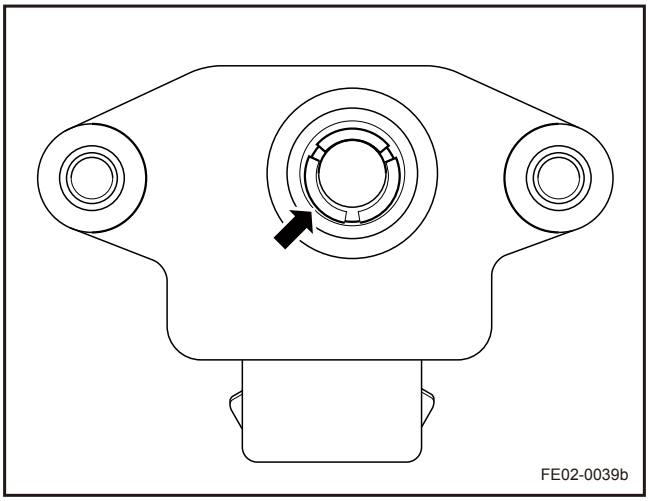
Removal Procedure:

Note

Refer to "Battery Disconnection Warning" in the "Warnings and Important Notices".




1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Remove the throttle body assembly. Refer to 2.6.8.5 Throttle Body Assembly Replacement.
3. Remove the throttle position sensor retaining bolts.




Installation Procedure:

1. Install and tighten the throttle position sensor retaining bolts.

   Note

   During the installation procedure align the throttle shaft groove with the sensor boss.

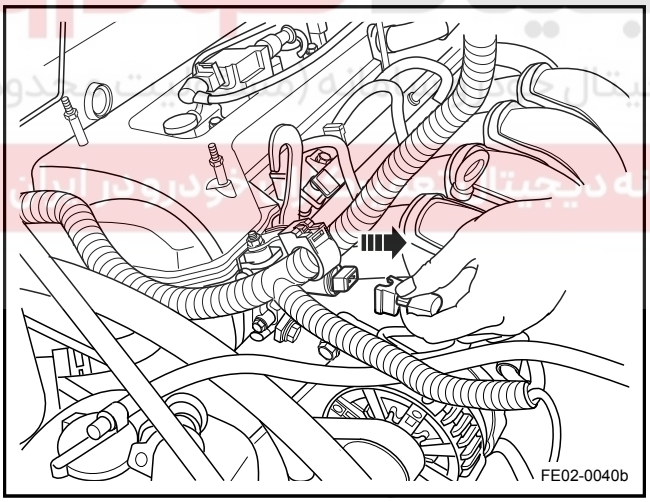
2. Install the throttle body assembly.
3. Connect the battery negative cable.

## 2.2.8.4 VVT Solenoid Valve Replacement and Filter Cleaning

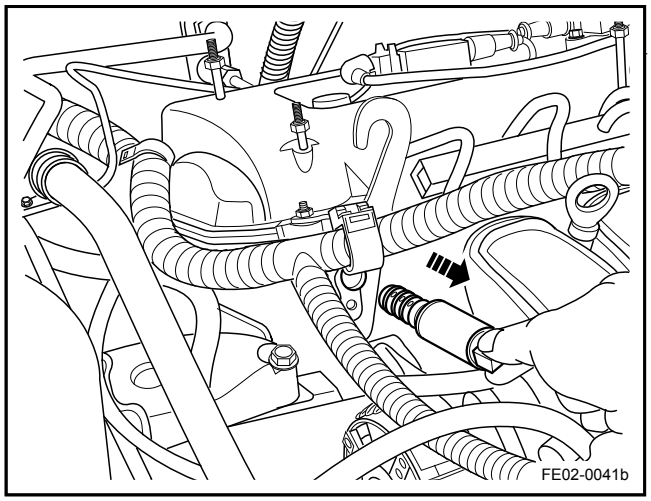
Removal Procedure:

Warning!

Refer to "Battery Disconnection Warning" in the "Warnings and Important Notices".




1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Remove the hood. Refer to 2.6.8.1 Plastic Engine Shield Replacement.
3. Disconnect VVT solenoid valve wiring harness connector.

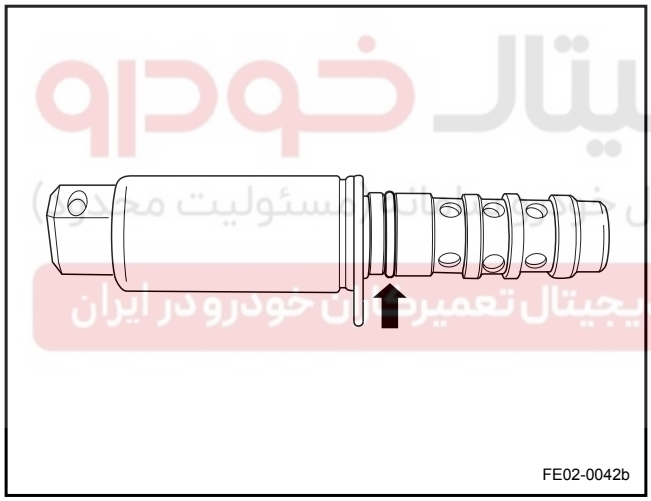



4. Remove VVT solenoid valve retaining bolts and remove the VVT solenoid valve.

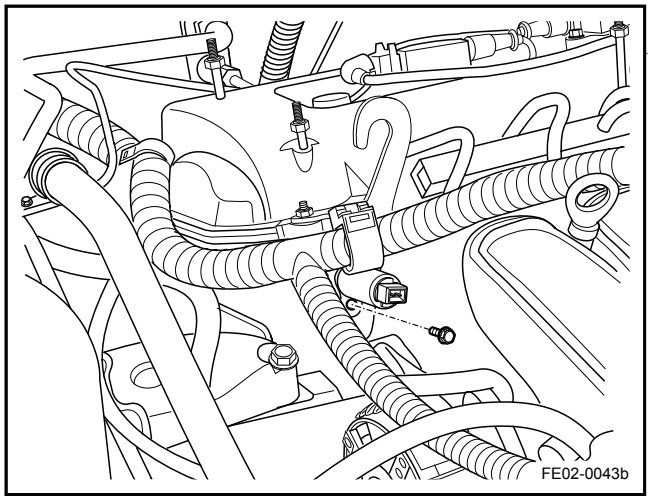
Installation Procedure:

Note

After replacing the VVT solenoid valve, you must carry out the "Clean Solenoid Valve Filter" procedure, other it cause electromagnetic valve damage.

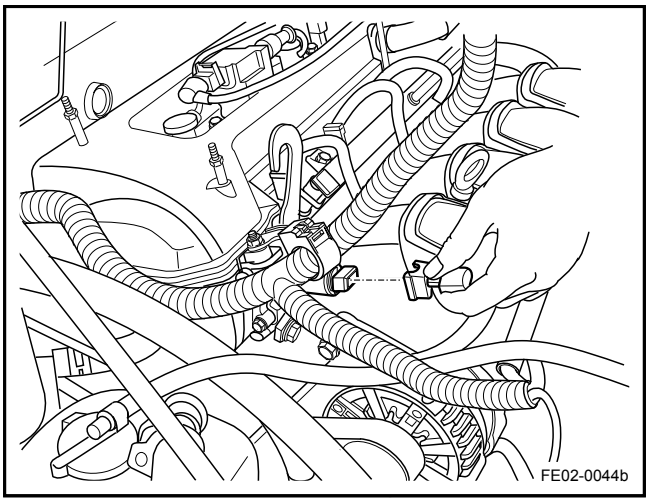



1. Make sure the new VVT solenoid valve seals are intact. Apply a small amount of engine oil on the seal.




2. Install the VVT solenoid valve and fasten the retaining bolts.

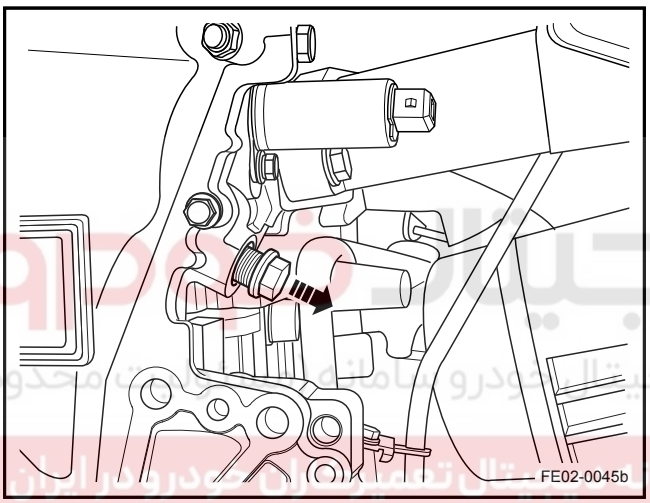
   Torque: 8 Nm (Metric) 6 lb-ft (US English)

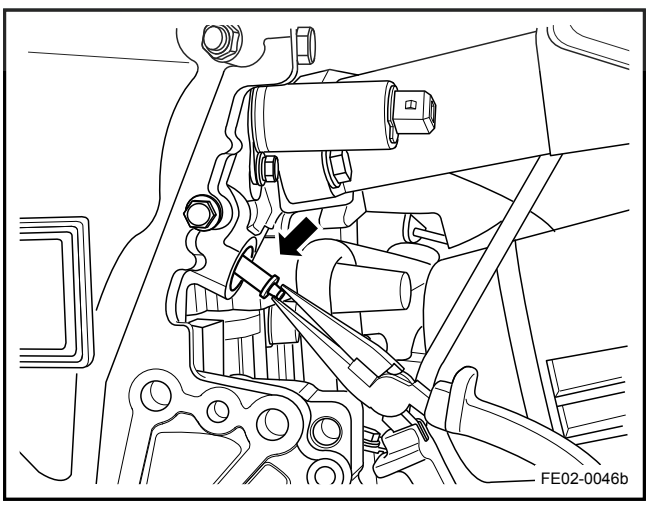



3. Connect the VVT solenoid valve wiring harness connector.

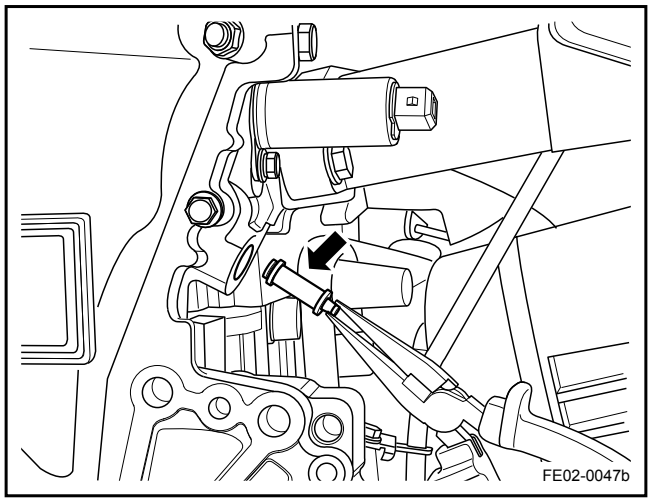
Clean the solenoid valve filter:

1. Remove the generator. Refer to 2.11.8.3 Generator Replacement.
2. Remove the VVT solenoid valve filter sealing bolts.

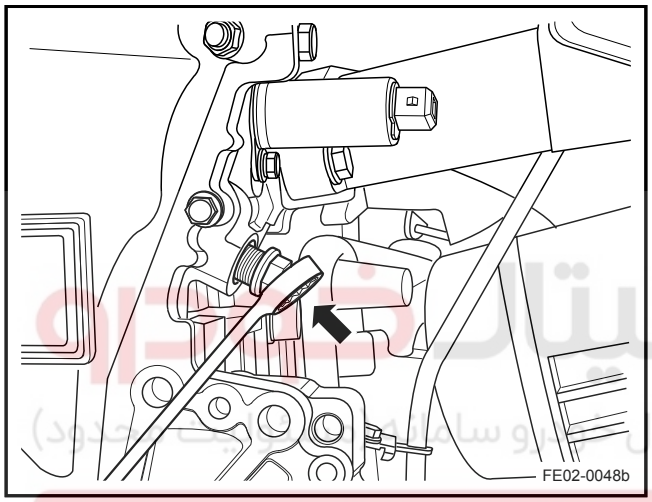



3. Remove the VVT solenoid valve filter with a plier.




4. Clean the filter and make sure the solenoid valve is not damaged or deformed, otherwise it must be replaced.
5. Install the VVT solenoid valve filter.




6. Install the solenoid valve filter and tighten the bolts.

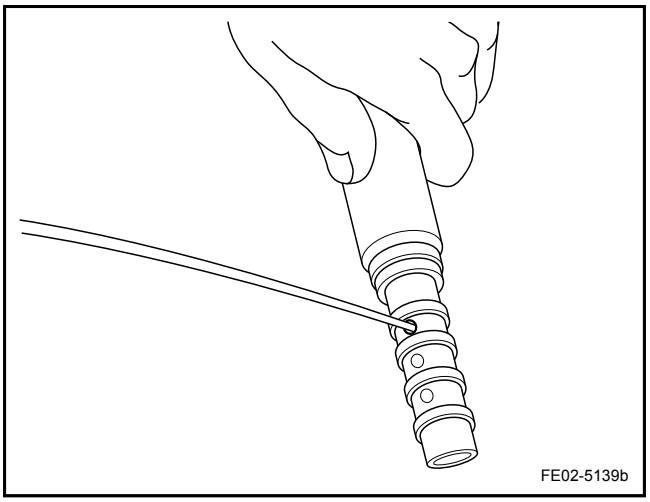
   Torque: 16.5 Nm (Metric) 12.2 lb-ft (US English)
7. Install the generator.
8. Connect the battery negative cable.



## 2.2.8.5 VVT Solenoid Valve Cleaning

Note

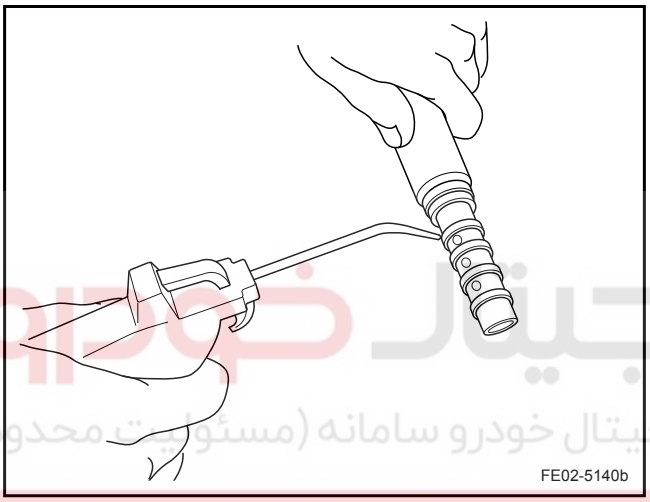
A. Inoperative near at high temperatures or near a fire to avoid cleaning agents being ignited or exploded.
B. The length of wire should be more than 3m. It is recommended to install the wire relay.
C. During the cleaning process, do not scratch the O-ring, scratch or knock the surface of the valve or drop the valve..
D. After repair, reinstall the valve VVT and tightening the bolt to 10 Nm.
E. Replace repeatedly cleaned VVT valve.



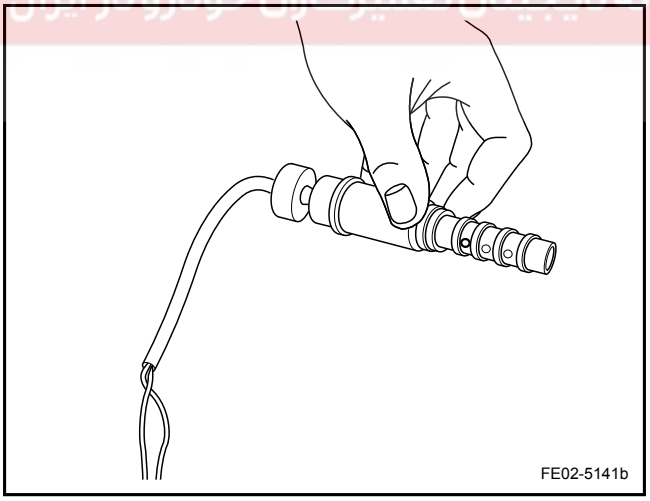

1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Remove VVT solenoid valve. Refer to 2.2.8.4 VVT Solenoid Valve Replacement and Filter Cleaning.
3. Clean the VVT solenoid valve hole, return hole, the chamber.

   Note

   During the cleaning process, keep the VVT solenoid valve and wiring harness connector upright, otherwise the cleaning agent will easily enter the VVT solenoid valve and cause internal damage.




4. Use an air gun to clean the VVT valve hole and oil chamber. Clean up the cleaning agent residue.




5. Switch on and off the VVT solenoid valve. Clean the valve with an air gun and repeat 2-3 times.

   Note

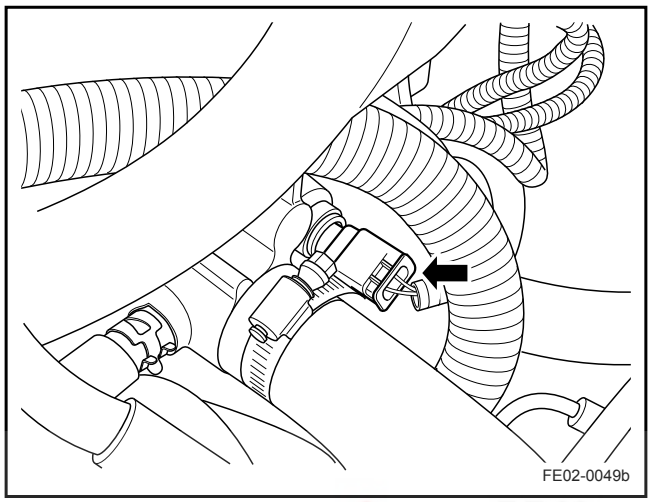
   Each time switch the valve on no longer than the 2 s, otherwise the VVT solenoid valve may be damaged.

## 2.2.8.6 Engine Coolant Temperature Sensor Replacement

Removal Procedure:

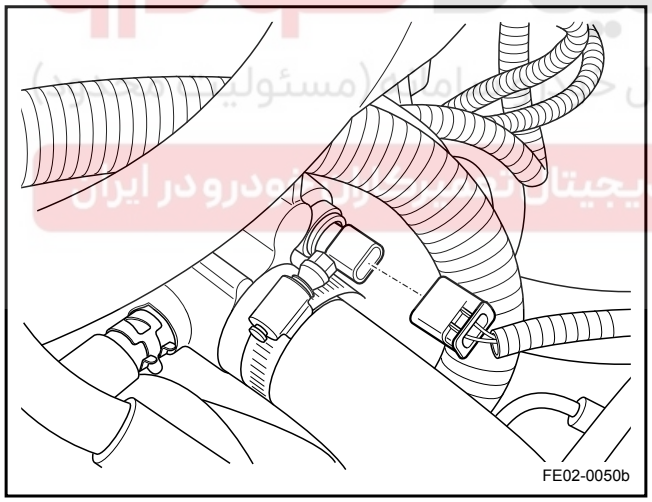
Warning!

Refer to "Cooling System Service Warning" in "Warnings and Notices".




1. Release cooling system pressure.
2. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
3. Disconnect the engine coolant temperature sensor wiring harness connector.
4. Remove the engine coolant temperature sensor.

Installation Procedure:

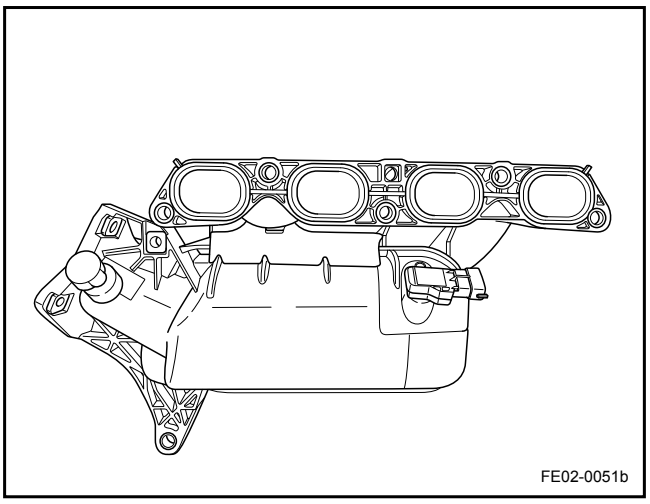



1. Apply sealant on the engine coolant temperature sensor thread.
2. Install the engine coolant temperature sensor.
3. Tighten the engine coolant temperature sensor.

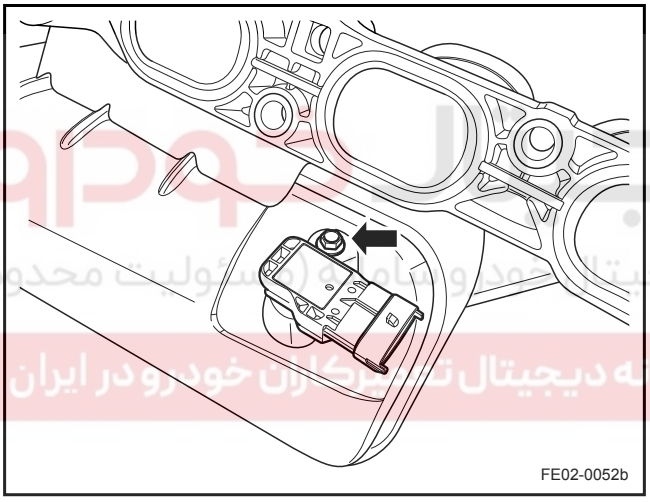
   Torque: 15 Nm (Metric) 11 lb-ft (US English)
4. Connect engine coolant temperature sensor wiring harness connector.
5. Fill the engine coolant.
6. Connect the battery negative cable.

## 2.2.8.7 Intake Air Pressure and Temperature Sensor Replacement

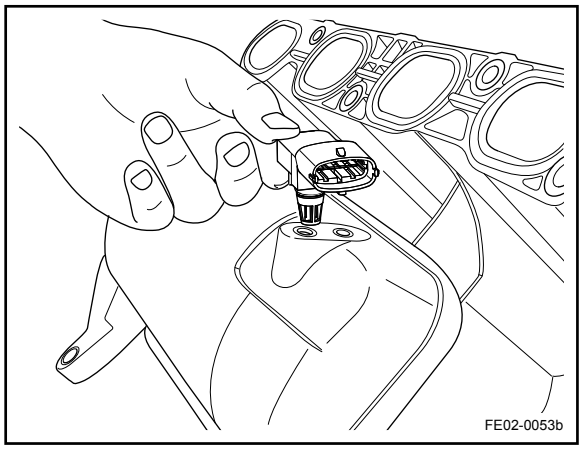
Removal Procedure:


FE02-0051b

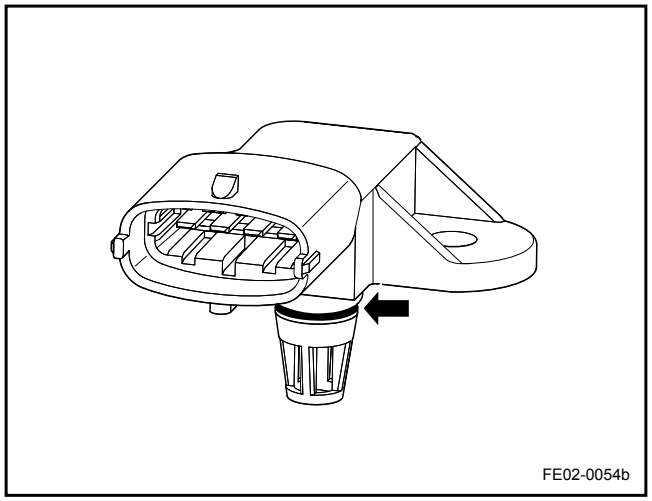
1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Disconnect intake air pressure and temperature sensor wiring harness connector.
3. Remove the intake manifold assembly. Refer to 2.6.8.6 Intake Manifold Assembly Replacement.


FE02-0052b

4. Remove the sensor retaining bolts.


FE02-0053b

5. Pull out the intake air pressure and temperature sensor.

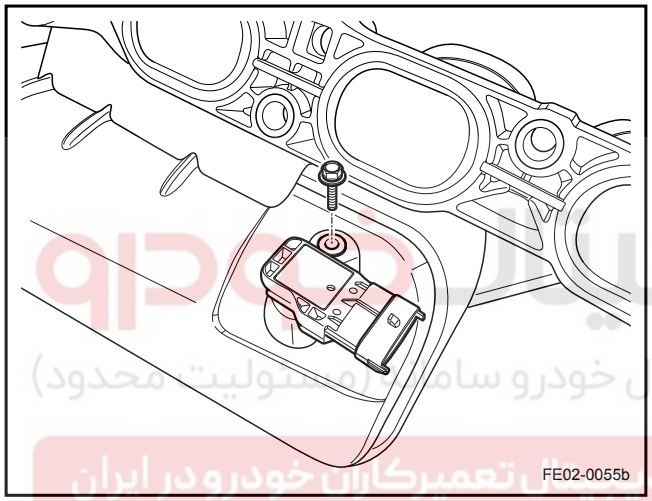

FE02-0054b

Installation Procedure:

1. Clean the intake air pressure and temperature sensor installation position and apply new seals.

   Note

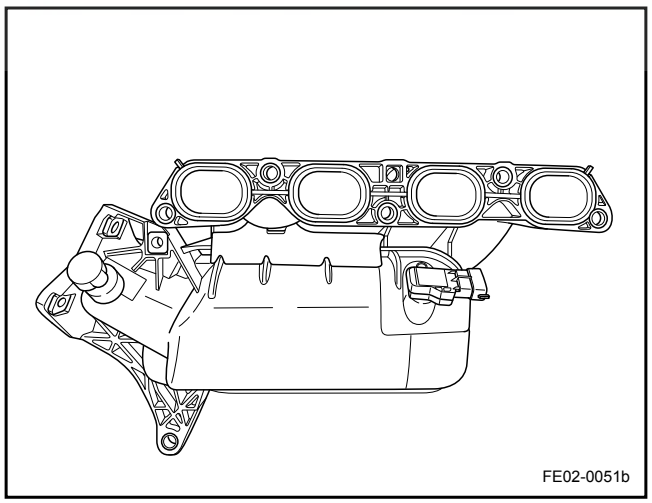
   The seal is single used only. After removal, a new seal must be installed.


FE02-0055b

2. Install the sensor retaining bolt.

   Torque: 9 Nm (Metric) 6.66 lb-ft (US English)




FE02-0051b

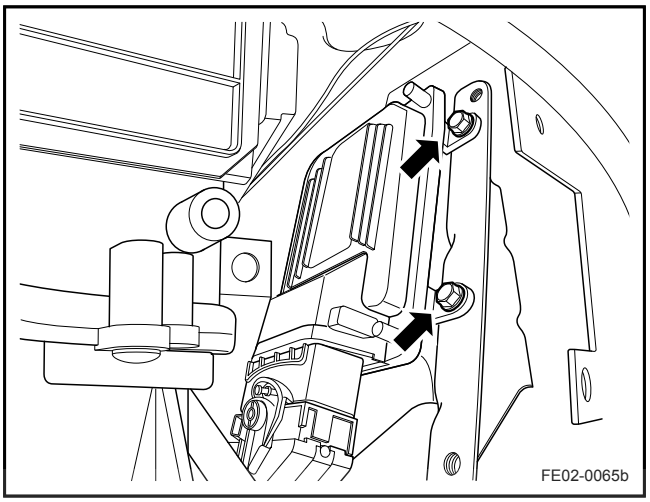
3. Install the intake manifold assembly.
4. Connect the intake air pressure and temperature sensors wiring harness connector.
5. Connect the battery negative cable.

## 2.2.8.8 Engine Control Module Replacement

Removal Procedure:

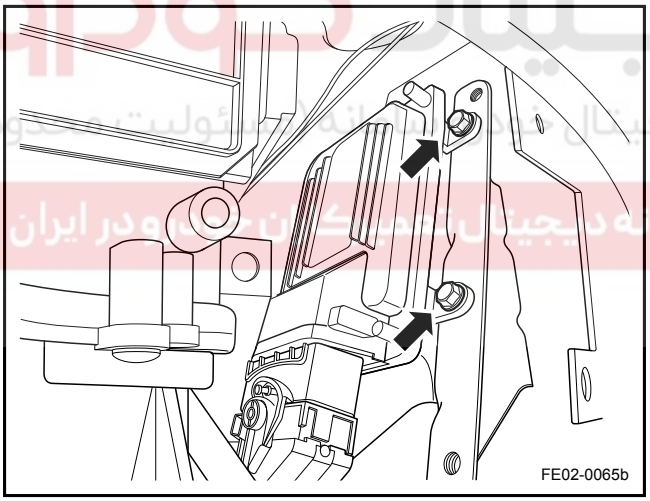
Warning!

Refer to "Battery Disconnection Warning" in "Warnings and Notices"




1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Remove the glove box. Refer to 12.8.3.2 Glove Box Replacement.
3. Disconnect the engine control module wiring harness connector.
4. Remove the engine control module retaining bolts.

Installation Procedure:




1. Install the engine control module retaining bolts.

   Torque: 9 Nm (Metric) 6.66 lb-ft (US English)
2. Connect the engine control module wiring harness connector.
3. Install the glove box.
4. Connect the battery negative cable.